November 11, 2004

VIA EXPRESS MAIL

Mr. Bob Boggs
California Department of Toxic Substances Control
700 Heinz Avenue, Suite 200
Berkeley, CA 94710-2721

Mr. James Ponton
Regional Water Quality Control Board
1515 Clay Street, Suite 1400
Oakland, CA 94612

RE: Presidio of San Francisco
Draft Small Arms Firing Ranges Feasibility Study Report

Dear Mr. Boggs and Mr. Ponton:

Enclosed for your review is the Draft Small Arms Firing Ranges Feasibility Study Report. We have enclosed two copies for the Department of Toxic Substances Control and one copy for Regional Water Quality Control Board review and comment.

Please contact me at (415) 561-4293 with any questions.

Sincerely,

for

Chris Nelson
Environmental Remediation Specialist

cc: Brian Ullensvang, National Park Service (NPS) (1 copy)
Doug Kern, Restoration Advisory Board (RAB) (1 copy)
Mark Youngkin, RAB (1 copy)
Presidio Trust Library (1 copy)
Remediation Library (1 copy)
Remediation File (1 copy)

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DRAFT
SMALL ARMS FIRING RANGES
FEASIBILITY STUDY REPORT

Prepared for:

The Presidio Trust
34 Graham Street, P.O. Box 29052
San Francisco, CA 94129-0052
415/561-5300 fax 415/561-5315

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34 Graham Street, P.O. Box 29052
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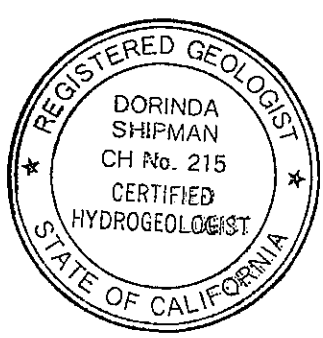
Dorinda Shipman, R.G., C.HG., Treadwell & Rollo, Inc.

11 November 2004

Date



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DRAFT
SMALL ARMS FIRING RANGES
FEASIBILITY STUDY REPORT

List of Acronyms and Abbreviations

APR	Annual Percentage Rate
Army	U.S. Army
Army Corps	U.S. Army Corps of Engineers
ARARs	Applicable or Relevant and Appropriate Requirements
AST	Above ground storage tank
BAPR	Barnard Avenue Protected Range
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CHP	California Highway Patrol Pistol Range
Cleanup Levels Document	*Development of Presidio-wide Cleanup Levels for Soil, Sediment, Groundwater, and Surface Water*
COCs	Contaminants of Concern
CULs	Cleanup Levels
cy	cubic yards
DTSC	Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
GGNRA	Golden Gate National Recreational Area
GMPA	*General Management Plan Amendment*
ICP/MS	Inductively Coupled Plasma/Mass Spectrometry
LCPR	Lobos Creek Protected Range
LCTB	Lobos Creek Target Butt
Land Use Controls	LUCs
LUCMRR	Land Use Control Master Reference Report
Main Installation FS	*Presidio Trust Revised Feasibility Study Report Main Installation Sites*
MGB	Machine Gun Butt
mg/kg	milligrams per kilogram
mg/L	milligrams per liter

List of Acronyms and Abbreviations (Continued)

MOA	Memorandum of Agreement
µg/L	micrograms per liter
NAPLs	non-aqueous phase liquids
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPS	National Park Service
NPV	Net Present Value
PCOCs	Potential Contaminants of Concern
Presidio	The Presidio of San Francisco, California
PRGs	preliminary remediation goals
PTMP	Presidio Trust Management Plan
RAB	Restoration Advisory Board
RAOs	Remedial Action Objectives
RAP	Remedial Action Plan
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RWQCB	Regional Water Quality Control Board
SAFRs	Small Arms Firing Ranges
SARA	Superfund Amendments and Reauthorization Act
SI	Site Investigation
STLC	Soluble Threshold Limit Concentration
TCLP	Toxicity Characteristic Leaching Procedure
TMV	Toxicity, Mobility and Volume
Trust	The Presidio Trust
Trust Act	Omnibus Parks and Public Lands Management Act of 1996
TTLC	Total Threshold Limit Concentration
WET	California Waste Extraction Test
Work Plan	*Work Plan for the Small Arms Firing Ranges Remedial Investigation/Feasibility Study*
XRF	X-ray fluorescence

EXECUTIVE SUMMARY

The Presidio Trust Feasibility Study (FS) Report for the Small Arms Firing Ranges (SAFRs) has been completed in general compliance with applicable requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and in accordance with the Presidio Trust (Trust) *Small Arms Firing Ranges Remedial Investigation/Feasibility Study Work Plan*, as approved by the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) in its letter, dated 8 July 2003. The purpose of the FS report is to develop remedial actions that are protective of human health and the environment, cost-effective, and allow reuse of the Presidio of San Francisco (Presidio) as intended under the *General Management Plan Amendment* (GMPA), dated July 1994, and the *Presidio Trust Management Plan* (PTMP), dated May 2002. Remedial actions in the FS Report have been evaluated to confirm compliance with requirements for preparing a Remedial Action Plan (RAP) under Section 25356.1 of the California Health and Safety Code.

The five SAFRs evaluated for this FS are:

- Lobos Creek Target Butt (LCTB);
- Lobos Creek Protected Range (LCPR);
- Machine Gun Butt (MGB);
- California Highway Patrol Pistol Range (CHP); and
- Barnard Avenue Protected Range (BAPR).

Based on the Remedial Investigations at each of these sites, it was determined that no further remedial action was required for three of the sites: LCTB, LCPR, and MGB. However, remedial action is warranted for the remaining two sites: CHP and BAPR. The following remedial alternatives were evaluated for these two sites:

- No Action;
- Institutional Controls (Land Use Controls);
- Capping Soil with Permeable Cover; and
- Excavation and Off-Site Disposal of Soil.

Based on a detailed evaluation using site-specific information and FS screening criteria, the recommended remedial alternative for CHP and BAPR is excavation and off-site disposal of the soil that exceeds cleanup levels.

1.0 INTRODUCTION

On behalf of The Presidio Trust (Trust), Treadwell & Rollo, Inc. has prepared this *Draft Small Arms Firing Ranges Feasibility Study (FS) Report.* The purpose of the FS Report is to identify and evaluate remedial alternatives that are protective of human health and the environment, cost-effective, and allow reuse of five historical SAFRs at The Presidio of San Francisco, California (Presidio) as required by the California Department of Toxic Substances Control (DTSC). The five SAFRs (Figure 1) that are included in this FS are:

- Lobos Creek Target Butt (LCTB),
- Lobos Creek Protected Range (LCPR),
- Machine Gun Butt (MGB),
- California Highway Patrol Pistol Range (CHP), and
- Barnard Avenue Protected Range (BAPR).

The Presidio is located in the City of San Francisco, at the northern tip of the San Francisco peninsula (Figure 1). The Presidio occupies approximately 1,491 acres and is bounded by San Francisco Bay on the north and the Pacific Ocean on the west. Densely populated residential areas of San Francisco border the Presidio to the south and east.

The Presidio was a U.S. Army (Army) installation from 1848 through 1994, serving as a mobilization and embarkation point during several overseas conflicts, a medical debarkation center, and a coastal defense for the San Francisco Bay area. Industrial operations formerly performed at the Presidio are associated with maintenance and repair of vehicles, aircraft, and base facilities. The Presidio also contains a number of landfills used by the Army for the disposal of municipal waste and construction debris.

In December 1988, the Secretary of Defense's Commission on Base Realignments and Closures recommended closure of the Presidio. Under Public Law 92-589, the Presidio was transferred to the National Park Service (NPS) on 1 October 1994 and became part of the Golden Gate National Recreational Area (GGNRA). As required by the Base Realignment and Closure Act, the Army initiated environmental studies in conjunction with the transfer of the property.

Section 103 of the Omnibus Parks and Public Lands Management Act of 1996, Public Law 104-333, 110 Stat. 4097 (Trust Act) created the Presidio Trust. The Trust is a federal government corporation established for the purpose of managing the leasing, maintenance, rehabilitation, and improvement of the non-coastal portions of the Presidio (Area B). The Trust manages Area B in accordance with the general objectives of the General Management Plan Amendment (GMPA) (NPS, 1994), section 1 of the Golden Gate National Recreation Area Act (Public law 92-589, 86 Stat. 1299, 16 USC 460bb), and the Presidio Trust Management Plan

(PTMP) (Trust, 2002). The NPS retained responsibility for Area A of the Presidio (the coastal portions of the Presidio) and manages Area A in accordance with the GMPA.

On 24 May 1999, the Army, the Trust, and NPS entered into a Memorandum of Agreement (MOA). Pursuant to this MOA, the Army delegated to the Trust its authority for the remediation of contamination at the Presidio (both Areas A and B).

These five small arms firing range sites collectively form Operable Unit 3 at the Presidio (DTSC, 1999). The Trust, as described below, determined that five SAFRs (LCTB, LCPR, MGB, CHP, BAPR) warranted further characterization beyond the Site Investigation (SI) stage conducted for the Army by Montgomery Watson. The FS was conducted in accordance with applicable U.S. Environmental Protection Agency (EPA) and DTSC guidance, specifically, *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final October 1988* (EPA, 1988b).

1.1 Purpose of Report

The purpose of the FS report is to identify and evaluate remedial alternatives to permanently address the risks which may be posed by the Small Arms Firing Range sites. The FS was performed in accordance with the approved *Work Plan for the Small Arms Firing Ranges Remedial Investigation/Feasibility Study* (Work Plan) (Treadwell & Rollo, 2002). The objective of the Remedial Investigation/Feasibility Study (RI/FS) process is not to remove all uncertainty about a site's characteristics and risk, but rather to gather sufficient information to support an informed management decision regarding which remedy would be the most appropriate for a site (EPA, 1988). The RI was completed in 2004 with results presented in the *Draft Small Arms Firing Ranges Remedial Investigation Report* (Treadwell & Rollo, 2004).

The RI/FS process represents the decision-making procedures to be followed for implementation of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 (commonly known as Superfund) as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] Part 300) outlines the specific steps to be followed in making remedy selection decisions for a site (EPA, 1990).

In conducting this RI/FS, the Trust will solicit regulatory agency and public review and comment including the following:

- Early consultation and coordination of corrective action alternatives and selection decisions with the Presidio Restoration Advisory Board (RAB), NPS, and regulatory agencies.
- Submittal of the Draft FS Report for stakeholder review and comment.

- Preparation of a responsiveness summary that responds to comments received on the FS. The responsiveness summary will be completed following receipt of stakeholder comments and will be included as Appendix A in the Final FS Report.
- Maintenance of an Administrative Record. Documents related to the RI/FS will be available to the public as part of the Administrative Record, maintained at the Presidio Library at 34 Graham Street, San Francisco.

Following the completion of the RI/FS, the sites will undergo the Remedial Action Plan (RAP) process to document the selection of the remedial action alternatives for the small arms firing range sites, in accordance with the State of California, DTSC Guidance Document No. EO-95-007-PP, RAP Policy (DTSC, 1995). In accordance with the DTSC guidance, the RAP will be subject to formal public review and comment.

1.2 Report Organization

This report is organized as follows.

- Section 1.0 describes the Presidio location, area background and historical environmental activities, and describes physical features of the five firing ranges;
- Section 2.0 describes the identification and screening of remedial technologies, identifies Applicable or Relevant and Appropriate Requirements (ARARs), summarizes contaminants of concern (COCs), discusses selection of site-specific cleanup levels, site-specific recommendations, identifies remedial action sites, addresses Principal Threat and Low-level Wastes, and identifies and screens general response actions, technologies, and process options;
- Section 3.0 describes the development and screening of alternatives;
- Section 4.0 discusses the detailed analysis of alternatives;
- Section 5.0 presents recommended remedial alternatives;
- Appendix A presents the Responsiveness Summary;
- Appendix B presents Remedial Investigation (RI) sampling results; and
- Appendix C contains the cost estimates and assumptions.

1.3 Site Background

Between the 1800s and the early to mid-1900s the Army used several SAFRs throughout the Presidio (Montgomery Watson, 1997). SAFRs are generally used for controlled firing of pistols, rifles, and shotguns. At the Presidio, SAFRs were specifically used by the Army for the training of military personnel. Presidio outdoor firing ranges were generally constructed with a target stop, target butt or impact berm to capture fired rounds of ammunition behind the target. Natural dune deposits or hillside slopes were often used as impact berms or butts. During use, some bullets fragmented or shattered upon impact. Additionally, some ammunition projectiles traveled past the target berm until they impacted a horizontal fall area.

Montgomery Watson completed the *Site Investigation for the Small Arms Firing Ranges at the Presidio* (SI) for the Army in July 1997. The scope of the SI included sampling at eight former SAFRs within the Presidio and analyzing for five COCs: antimony, barium, copper, lead, and zinc. Samples were analyzed using energy dispersive X-ray fluorescence (XRF) as a field screening tool to assess whether additional sampling was required to define the vertical and horizontal extent of the contamination. To confirm high concentrations of XRF results for lead and barium at each site, 20 percent of the samples were reportedly sent to a fixed laboratory for analysis by EPA Method 6010 (Montgomery Watson, 1997). Based on the results of the field and laboratory analyses for each firing range, the sites were screened to determine whether additional investigation was warranted. Lead was considered the primary COC.

Previous Presidio-wide studies have presented detailed background and physical characteristics information on the Presidio including the Army's RI (Dames & Moore, 1997) and the *Presidio Trust Revised Feasibility Study Report Main Installation Sites* (Main Installation FS) (EKI, 2003). The background information presented in this FS report is focused on five SAFRs and the affected soil media. A historical summary of the small arms firing range activities is presented in Table 1. Appendix B presents a summary of the historical RI results.

The COCs identified for the RI included antimony, barium, copper, lead, and zinc. Because lead is the main component of ammunition (with respect to mass of the projectile), it was considered the primary COC; whereas, the other COCs are typically minor constituents of ammunition.

Surface and near-surface soil samples were collected from the five SAFRs and analyzed for the COCs (antimony, barium, copper, lead, and zinc). A portion of the samples (10%) were analyzed for 14 additional SW6010/6020 metals (arsenic, beryllium, cadmium, chromium, cobalt, nickel, selenium, silver, thallium and vanadium, plus aluminum, iron, magnesium, and manganese). The results were compared to cleanup levels to confirm that only antimony, barium, copper, lead, and zinc are the appropriate COCs and that the nature of the contamination has been adequately characterized. Aluminum, iron, magnesium, and manganese results were to be considered only if additional background metals evaluation was warranted.

The potential pathways of migration of COCs identified in the RI are:

- Air migration – emissions of airborne particulates,
- Surface water migration – contamination of sediments, and
- Sediment migration – from rodents, excavation, and dune restoration activities.

The emission of particulates typically occurred as the small arms were discharged during target practice. Fine particulates, composed of metals in the gunpowder and minute fragments of the projectile, are released and disperse in an area nearest to the firing line. The fine particulates are deposited on the ground surface and can migrate into the soil through subsequent rain infiltration. The fine airborne particulates can also be transported by surface water runoff and deposited in sediments of streams. The projectiles that penetrate the target butt can be further transported from their initial deposit by soil movement, either due to natural process or human activity.

The SAFRs COCs are chemically and physically persistent in the shallow soil. Elemental metals are not readily biodegradable, and therefore remain in the soil. Some metals oxidize or undergo transformation into chemical complexes which make them more soluble and can be transported in the soil via rainwater infiltration or they become accessible to plant uptake via chelation. However, if the plant material containing the chelated metal is not physically removed from the site, the metals will re-enter the soil as the plant dies and decomposes.

The SAFRs COCs are relatively immobile after their initial deposition. As stated above, rainwater infiltration can cause the minute particulates and soluble fractions to migrate into the soil. However, this process is typically limited to the upper few feet of the soil column. If the pH of the soil is relatively low (acidic), then the soluble fraction of the COCs can potentially migrate further and can at times enter the groundwater. However, most groundwater has a natural buffering capacity (neutral pH) which causes a majority of these dissolved metals to precipitate and retards migration in the groundwater.

The bullets typically do not penetrate the target butt more than a few inches to a few feet, depending on the density and compaction of the target butt soil. The bullets are typically larger and denser than the material that makes up the target butt. As such, through natural unconsolidated soil movement caused by rainwater infiltration and biological disturbance, these bullets and bullet fragments will tend to become exposed at the ground surface over time.

The most significant cause for COC migration at the SAFRs is from human activities, specifically soil excavation and surface grading. As discussed above, the target butts at several of the historical SAFRs have been covered, removed, or graded and are no longer clearly discernable.

A brief description of the SAFRs and the nature and extent of contamination based on RI results is presented below. The COCs identified for the FS and the selection of cleanup levels are described in Section 2.0.

1.3.1 Lobos Creek Target Butt

The LCTB was located south of former Building 1788 in the Lobos Creek Area (Figure 1). Lobos Creek is located approximately 75 feet west of the target butt (Figure 2). The LCTB was used from approximately 1896 to 1902 (U.S. Army Corps of Engineers [Army Corps], 2003). Maps indicate the historical footprint of the LCTB to be 270 feet long by 20 feet wide. Shooting is presumed to have been from east to west. The LCTB appears as a sandy rise east of the pumphouse (Building 1786) approximately 255 feet long, 56 feet wide, and 4 feet high, with a 300-foot firing line. The rise is densely covered by grasses, trees, and small brush but no sensitive vegetation exists at the LCTB (NPS, 2001a). The lithology of the LCTB is comprised of beach/dune sand (Schlocker, 1974). The entire Lobos Creek Area is designated as an archeologically sensitive area (NPS, 2001b).

Soil impacts have been identified at one sample location in the former soil berm/backstop (LCBSB24) and at one location adjacent to Lobos Creek (LCBSB36) (Figure 2). At LCBSB24, the soil sample collected at 1 foot below ground surface (bgs) contained copper at 56 milligrams per kilogram (mg/kg) which exceeded the cleanup level (Table B-1). However, a duplicate sample (DUP072403B) collected at that location at 1.5 feet bgs and a deeper sample collected at 2.5 feet bgs did not contain copper greater than the cleanup level (43 mg/kg). At this location, the copper concentration is bound vertically and laterally by samples with no cleanup level exceedances (Figure 2).

At LCBSB36, the soil samples at 0.3 and 1 foot bgs contained zinc at 94 mg/kg and 70 mg/kg, respectively. The zinc concentration in a deeper duplicate sample (DUP073103A at 1.5 feet bgs) did not exceed the cleanup level for zinc. Because the zinc concentration in the duplicate sample is below the cleanup goal, no deeper samples are warranted. The lateral extent of this isolated zinc exceedance is bounded on three sides. The unbounded side is adjacent to Lobos Creek.

1.3.2 Lobos Creek Protected Range

The LCPR was located north of Lake Street and east of the LCTB (Figure 1). The LCPR was used from approximately 1902 to 1910 (Army Corps, 2003 and Montgomery Watson, 1997). Historical maps depict the LCPR as an elongated strip running northwest to southeast approximately 900 feet long by 30 feet wide (Montgomery Watson, 1996). An asphalt parking and garage area associated with the construction of Buildings 1750, 1752, 1753, and 1754 now overlies the historical footprint (Figure 3). Native lithology at the LCPR is beach/dune sands (Schlocker, 1974). As mentioned in Section 1.2.1 above, the Lobos Creek Area is designated as an archeologically sensitive area, although such features have not been identified within the

LCPR (Montgomery Watson, 1997). Past excavations have occurred at this site as part of dune reconstruction and revegetation activities (NPS, 1998). As a result of the restoration, a large area of the LCPR has been designated an ecologically sensitive area (Figure 3). Specifically, the San Francisco Lessingia, Spineflower, Wallflower, and Dune Gilia are present at LCPR and are considered to be special status plants in the State of California (NPS, 2001a).

Soil impacts are identified at two sample locations, one north of Building 1750 (LCPSB37) and one east of Building 1750 (LCPSB27) (Figure 3 and Table B-2). At LCPSB27, the shallow (1 foot bgs) soil sample contained a zinc concentration of 110 mg/kg that exceeded the cleanup level. The zinc concentration in the deeper sample (2 feet bgs) was less than the cleanup level. Therefore, the vertical extent of the zinc exceedance is defined (Figure 3). This sampling location is bounded to the south by a paved area, to the west by Building 1750, and to the north by sampling location LCPSB29 where samples contained zinc concentrations that are less than the cleanup level.

At LCPSB37, the shallow (1 foot bgs) soil sample from this location contained a zinc concentration (85 mg/kg) that exceeds the cleanup level (66 mg/kg). The zinc concentrations in a deeper sample (2 feet bgs) and in a deeper duplicate sample (DUP0272303B) were less than the cleanup level. At this location, the vertical extent of the zinc exceedance is defined. The lateral extent at this location is bounded to the south by Building 1750 and to the north by sample location LCPSB36 where zinc concentrations were less than the cleanup level.

1.3.3 Machine Gun Butt

MGB is located in Crissy Field south of former Building 637 (Figure 1). The MGB was used during the late 1930s and early 1940s (Montgomery Watson, 1996). Historically, the MGB was designated as Structure 635 and encompassed an area of approximately 50 feet by 50 feet (Figure 4). The bedrock slope may have served as a backstop (Montgomery Watson, 1997). A motor pool area was constructed at the site following its use as a firing range. The motor pool area included several above ground storage tanks (ASTs). In 1993, the ASTs and associated piping were removed, and soil impacted with petroleum was excavated from the site. Approximately 736 cubic yards of soil were hauled off-site and disposed at the BFI and Forward landfills as Class II and Class III wastes, respectively (Ramos Engineering, 1993). Soil to approximately 18 inches bgs was removed from beneath the ASTs and pump islands (EKI, 1999). Based on the confirmation sampling conducted by the Army, petroleum hydrocarbons and related constituents appear to have been removed from the soil to below applicable cleanup levels (EKI, 1999). In 1999, the Building 637 Area underwent a removal action to address contaminated groundwater and soil. Removal activities included excavation of contaminated vadose zone soil from the site, treatment of residual hydrocarbons in the smear zone, and establishing a monitoring well network to monitor contaminated groundwater (EKI, 2000). Sampling activities associated with the tank removals at the MGB did not include metal analyses. Samples were only tested for petroleum hydrocarbons and related constituents.

Currently, the MGB is devoid of ASTs and is paved with asphalt in front of the hillside (Figure 4). A 6-foot-high chain link fence runs the length of the site, and the hillside is densely vegetated with poison oak, blackberry bushes, and ivy. There are areas with sensitive vegetation species adjacent to the MGB (Figure 4) (NPS, 2001a). The lithology of the MGB is Franciscan Formation (serpentinite) and beach/dune sand (Schlocker, 1974). However, Colma lithology was also observed during the RI sampling.

Soil impacts at the MGB are identified at one location in the east hillside (MGBSB19 and at one location in the lower middle hillside (MGBSB04). These locations are shown on Figure 4, and the RI data is presented in Table B-3.

At MGBSB04, the shallowest soil sample (1 foot bgs) exceeded the cleanup level for zinc. The deeper sample (2 feet bgs) contained zinc at a concentration less than the cleanup level; therefore the metal exceedance is defined vertically (Figure 4). The lateral extent is defined by soil samples from locations MGBSB03, MGBSB05, and MGBSB13 that did not contain metal concentrations exceeding the cleanup levels.

At sample locations MGBSB06 and MGBSB16, the shallow soil samples (1 foot bgs) contained cadmium at 1.2 mg/kg and 1.7 mg/kg, respectively. Both locations exceeded the cleanup level for cadmium. Because cadmium is not associated with firing ranges and the reported concentrations may not accurately represent site conditions (as discussed Section 2.1.2), cadmium was not considered a soil COC.

The shallow soil sample (0.3 feet bgs) from location MGBSB19 contained zinc just above the cleanup level (60 mg/kg) at 76 mg/kg. At this location, bedrock was encountered at 6 to 9 inches bgs that prevented further delineation of the deeper soil. The sample location is on the study area perimeter, and is bounded on the west by three samples with zinc concentrations less than the cleanup level.

1.3.4 California Highway Patrol Pistol Range

The CHP is located in the northern part of the Presidio near the Golden Gate Visitor Center and the Golden Gate Bridge toll booths (Figure 1). The CHP was used from 1944 until 1964 and was approximately 50 feet wide by 60 feet long (Army Corps, 2003 and Montgomery Watson, 1997). The CHP is located in an archeologically sensitive area within the Battery East, north of a scenic viewing area and parking lot (Figure 5). The Battery East was constructed in 1876 and is a contributing feature to the Presidio National Historic Landmark District designation (NPS, 1993). A sidewall of the gun battery is beneath the subsurface and is similar to an ammunition bunker. This portion of the gun battery served as the backstop when the firing range was operational (Montgomery Watson, 1997). The CHP firing line was constructed on concrete, and presently the area in front of the firing line and targets is paved with asphalt. No samples were taken during the SI from beneath the asphalt or concrete. The backstop is 10 feet high and is

covered by dense vegetation. The entire battery and earthworks of the CHP is considered to be an archeologically sensitive structure (NPS, 2001b). Native lithology at the CHP is Franciscan Formation (serpentinite) (Schlocker, 1974). However, collected RI soil samples were representative of beach/dune sand and Colma lithologies.

Soil impacts are identified west of the paved area, within the paved picnic area, in the former backstop (target butt), and two locations north of the paved picnic area. These locations are shown on Figure 5 and the RI data is presented in Table B-4.

Sampling locations CHPSB02 and CHPSB03 are located west of the paved picnic area, near the paved walkway. The shallow soil samples (0.3 feet bgs) at both locations exceeded cleanup levels for lead and zinc (160 mg/kg and 60 mg/kg). Lead concentrations ranged from 180 mg/kg in CHPSB02 to 220 mg/kg in CHPSB03. The deeper samples at these locations (1 and 2 feet bgs) did not exceed the cleanup levels for these metals; therefore, the vertical extent has been defined (Figure 5). The lateral extent of impacts can be defined as part of future remedial action confirmation sampling.

At sample location CHPSB12 on the hillside south of the firing range, cadmium was the only metal that exceeded the cleanup levels, based on the Inductively Coupled Plasma (ICP) data. As discussed in Section 2.1.2, cadmium is not present based on ICP/Mass Spectrometry (ICP/MS) results in other samples and was not retained as a COC.

At sample locations CHPSB23 and CHPSB24, located within the paved area of CHP, shell casings were observed during RI field activities (Figure 5). The metals detected above the cleanup levels include copper, and zinc. At locations CHPSB22 and CHPSB25, cadmium was reanalyzed using the ICP/MS method and both cadmium results were non-detect. The vertical extent of zinc is not defined at locations CHPSB23 (2.5 feet bgs) or at CHPSB27 (3 feet bgs). The lateral extent is also not defined to the north. However, because of the physical constraints of this area (steep inaccessible slopes), the lateral extent can not be defined. The lateral extent of impacts south of CHPSB24, where copper and zinc exceeded cleanup levels, can be defined during remedial action confirmation sampling.

Sample locations CHPSB05, CHPSB06, CHPSB07, and CHPSB20 are in the former backstop (target butt) of the CHP Pistol Range. The soil in this area was placed against the brickwork of the historical military battery (Battery East). Antimony, copper, lead, and zinc were detected at concentrations greater than the cleanup levels at these locations. Bullets were present in samples collected at CHPSB06 and CHPSB07 (Figure 5). At three of the four locations, the metal concentrations decrease with depth to concentrations less than the cleanup levels. Because only a shallow sample was collected at CHPSB05, the vertical extent at that location is unknown, but is bounded laterally by other adjacent sample locations that demonstrate a decrease in concentration with depth. Therefore, the lateral extent of metals in this portion of the study area is defined.

Soil samples that contained total lead concentrations exceeding the Soluble Threshold Limit Concentration (STLC) by a factor of 10 or exceeding the total threshold limit concentration (TTLC) were also analyzed for soluble lead. The soluble lead concentrations are used to classify soil for disposal purposes. Typically these analyses are performed as part of the FS to evaluate and estimate treatment or disposal costs; however, these analyses were performed in conjunction with the RI to reduce potential future sampling. Seven soil samples were analyzed for soluble lead using the WET test to compare with STLC values: CHPSB02[0.3], CHPSB03[0.3], CHPSB05[1], CHPSB06[1], CHPSB07[1], CHPSB07[2], and CHPSB07[3]. Three of these samples were also analyzed for soluble lead using the Toxicity Characteristic Leaching Potential (TCLP) test: CHPSB05[1], CHPSB06[1], and CHPSB07[1].

The analytical results of the soluble lead tests indicate that soil samples containing total lead concentrations greater than the TTLC value for lead (1,000 mg/kg) also exceed the STLC value for lead (5 milligrams per liter [mg/L] or 5,000 micrograms per liter [µg/L]) and the TCLP value for lead (5 mg/L or 5,000 µg/L). These results indicate that soil exceeding the lead cleanup level that may be excavated as part of site remediation activities will require special handling and disposal appropriate for a Federal, hazardous waste.

1.3.5 Barnard Avenue Protected Range

The BAPR is located in a canyon east of Barnard Avenue, and Building 42 (Figure 1). A portion of the range is overlain by Landfill E (Figure 6). According to historical maps of the Presidio, the range first appeared in approximately 1907 (Army Corps, 2003) and was not present after 1934, although the exact years of use are not known. It appears to have had four target butts, the furthest one extending out approximately 1,000 feet (Historical Map, 1909). Prior to disposal operations at Landfill E, the area was a ravine, and wastes were dumped into the ravine (Montgomery Watson, 1999). In 1946, landfilling operations began and continued until approximately 1973 (Montgomery Watson, 1999). The native lithology of the BAPR is Colma Formation (Dames & Moore, 1997). However, beach/dune sand was also observed in collected RI soil samples. Currently, the canyon is heavily vegetated with low brush plants such as blackberry bushes and trees. There is a sensitive habitat located on the west side of the northern portion of BAPR (NPS, 2001a). Two groundwater seeps are located on the northern portion of the site (EKI, 1998). Also, the Pop Hicks Ballfield, a baseball diamond, was constructed in the mid-1950s and is located on the southern portion of Landfill E (Figure 6).

Soil impacts were identified at three locations surrounding Building 809 in the northeast portion of the study area (BAPSB02, BAPSB03R, and BAPSB04) and at two locations in the west perimeter of the study area bordered by sensitive vegetation (BAPSB13, and BAPSB18) (Figure 8). RI data is presented in Table B-5.

The shallow (1 foot bgs) sample from BAPSB12 contained cadmium exceeding the cleanup level. Because cadmium is not associated with firing ranges and the reported concentrations may

not accurately represent site conditions (as discussed Section 2.1.2), cadmium was not retained as a COC.

The shallow (0.3 feet bgs) sample from BAPSB13 contained cadmium and zinc greater than the cleanup levels. Cadmium and zinc were detected in the sample at 1.7 mg/kg and 210 mg/kg respectively. The deeper (1 foot bgs) sample contained only cadmium greater than the cleanup level based on the ICP data. The BAPSB13 sample extracts were reanalyzed for cadmium using ICP/MS and cadmium was not detected above laboratory reporting limits. Based on the shallow soil cleanup level exceedance for zinc, the lateral extent of contamination has not been defined.

The shallow (0.3 feet bgs) sample from BAPSB18 contained copper and zinc greater than the cleanup levels at 70 mg/kg and 350 mg/kg, respectively. The deeper (1 foot bgs) sample contained only zinc at a concentration greater than the cleanup level at 98 mg/kg. Therefore, the vertical and lateral extent of zinc contamination has not been defined at this location.

At sampling location BAPSB10, the shallow (1 foot bgs) sample contained cadmium above cleanup levels at 1.2 mg/kg based on ICP results. Cadmium was reanalyzed using ICP/MS, with no detection and as discussed in Section 2.1.2, not retained as a COC.

Sampling locations BAPSB02, BAPSB03R, and BAPSB04 each are adjacent to Building 809 at the northeast corner of the study area. Soil samples from each of these contained zinc concentrations exceeding the cleanup level, and the shallow sample at BAPSB03 also contained lead exceeding the cleanup level. Concentrations of zinc ranged from 81 mg/kg in BAPSB02[3] to 200 mg/kg in BAPSB03R[5.5]. Lead was also detected at 230 mg/kg in BAPSB03R[5.5]. Based on these results the lateral extent of contamination has not been defined. The deepest samples from each of these locations did not contain metal concentrations exceeding the cleanup levels; therefore the vertical extent of metals has been defined (Figure 6).

One soil sample contained total lead concentrations exceeding the STLC by a factor of 10. Soil sample BAPSB03R[5.5] was analyzed for soluble lead using the WET test for comparison with STLC values. The soluble lead concentrations are used to classify soil for disposal purposes. Typically this analysis is performed as part of the FS to evaluate and estimate treatment or disposal costs; however, this analysis was performed in conjunction with the RI to reduce potential future sampling efforts.

Sample BAPSB03R[5.5] WET results were non detect at < 1,500 µg/L which is less than the STLC value for lead (5 mg/L or 5,000 µg/L). This result indicates that the soil is not a hazardous waste.

2.0 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES

This section presents the remedial action objectives, identifies potential ARARs, the FS COCs and associated cleanup levels, which sites require remedial action, and the potential remedial technologies that could be used to achieve the remedial action objectives (RAOs). The identified remedial technologies are then screened to determine which technologies should be retained and developed into remedial alternatives.

2.1 Remedial Action Objectives

RAOs consist of media-specific or operable unit-specific goals for protecting human health and the environment (EPA, 1988). The RAOs consist of implementing the site-specific cleanup levels.

2.1.1 Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA, 42 U.S.C. § 9621(d), requires remedial actions to attain or justify the waiver of applicable, or relevant and appropriate, federal and state environmental or state facility siting requirements. These applicable or relevant and appropriate requirements are referred to as "ARARs". Federal ARARs may include requirements promulgated under any federal environmental laws. State ARARs may only include promulgated, enforceable environmental or facility-siting laws of general application that are more stringent or broader in scope than federal ARARs and that are identified by the state in a timely manner. The DTSC, the lead state agency overseeing CERCLA cleanup activities at the Presidio, has reviewed the potential State ARARs identified as part of this process.

Applicable requirements are those cleanup standards, standards of control, criteria, or limitations that specifically address conditions, circumstances, or activities at a site. Relevant and appropriate requirements are those cleanup standards, standards of control, criteria, or limitations that, while not directly "applicable" to conditions, circumstances, or activities at the site, address problems or situations sufficiently similar to those encountered at the site that their use is well suited to the site. A requirement that is not directly applicable must be both relevant and appropriate based on site-specific factors to be an ARAR. The criteria for determining relevance and appropriateness are listed in the NCP, 40 CFR § 300.400(g)(2).

Nonpromulgated advisories or guidance issued by federal or state government are not legally binding and do not have the status of potential ARARs. Such advisories or guidance, which are termed "To-be-Considered" (TBC) material, are used during the cleanup process to further the goal of protecting human health and the environment.

ARARs only include substantive, not administrative, requirements, and pertain only to onsite matters. Any off-site activities must comply with all applicable federal, state, and local laws, including both substantive and administrative requirements.

As discussed above, the purpose of the FS is to develop remedial alternatives that are protective of human health and the environment, cost-effective, and consistent with planned reuse. Part of this process includes an evaluation of ARARs to establish on-site cleanup standards. Potential ARARs that may apply to any of the SAFRs are presented in this FS report. ARARs for a particular site will be finalized as part of the RAP process for each small arms firing range requiring remedial action. Table 2 summarizes ARARs for the sites, including legal citations and specific locations where an ARAR may be expected to apply. In the event of a discrepancy between the text and Table 2, the information in the table shall prevail. Because groundwater is not a media of concern for these sites, groundwater protection ARARs are not applicable or relevant and appropriate.

ARARs are identified on a site-specific basis from information about the chemicals at the site, the actions that may take place at the site, and the features of the site location. There are three general ARAR categories:

- chemical-specific,
- action-specific, and
- location-specific.

Chemical-specific ARARs are numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values. They are used to determine acceptable concentrations of specific hazardous substances, pollutants, and contaminants in the environment. If a chemical is subject to more than one numerical value or methodology, the most stringent is generally selected.

Location-specific ARARs are restrictions placed on the concentration of hazardous substances, pollutants, or contaminants or the conduct of activities solely because they are in specific locations, such as wetlands or floodplains.

Action-specific ARARs are technology- or activity-based requirements or limitations on actions taken with respect to hazardous substances, pollutants, or contaminants.

The Trust's analysis and identification of chemical-specific, location-specific, and action-specific ARARs for the SAFRs follow EPA guidance, including *CERCLA Compliance with Other Laws Manual Part 1 (Interim Final)*, EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9234.1-01, August 1988 (EPA, 1988a), and the *CERCLA Compliance with Other Laws Manual: Part II, Clean Air Act and Other Environmental Statutes and State Requirements (Interim Final)*, OSWER Directive 9234.1-02, August 1989 (EPA, 1989a).

As discussed in Section 1, the purpose of the FS report is to identify and evaluate remedial alternatives that are protective of human health and the environment, cost-effective, and allow reuse of the five historical SAFRs at the Presidio. Part of this process is to identify and evaluate ARARs to establish on-site cleanup standards. Potential ARARs are identified for all SAFRs and are summarized in Table 2. Comments regarding their specific applicability are provided on the summary table. Because groundwater is not a media of concern for these sites, groundwater protection ARARs are not applicable or relevant and appropriate and are therefore not included in Table 2.

2.1.2 Contaminants of Concern for the Feasibility Study

The site contaminants are those associated with the ammunition fired at SAFRs. Such ammunition generally contains a projectile (bullet or ball), cartridge case or shell casing containing the bullet, and an ignition system or cap. The bullet or ball consists of a lead alloy that contains some copper, tin and antimony (Montgomery Watson, 1997). Antimony is a hardening agent used in bullets, and copper and zinc are primary components in shell casings and jackets (Pro Act, 1998). The ignition primers are composed of lead styphane and barium nitrate (Montgomery Watson, 1997). According to the military specification MIL-L-13283B, the ammunition typically used by military services usually contains bullets comprised of 90.0 to 99.2 percent lead and antimony, with lead as the primary component (Montgomery Watson, 1997).

Because lead is the main component of ammunition, it is considered the primary COC. Normal operation of a small arms firing range can elevate lead concentrations in soil several percent (one percent = ten thousand parts per million). Antimony, barium, copper, and zinc are generally found in lower concentrations in the environment (Pro Act, 1998). These four metals plus lead were considered COCs for the RI investigation.

Antimony, reported as a potential metal alloy to harden lead bullets, was only detected in two of the RI soil samples collected at CHP. These results indicate that although antimony may be a common component of the metal alloy in lead ammunition, elemental antimony is not commonly present in soil samples at concentrations above detection limits at the Presidio SAFRs.

The RI analytical results were compared to the cleanup levels to assess the nature and extent of contamination at the small arms firing range sites and to evaluate remedial alternatives. Although barium was a COC for the RI based on its association with small arms munitions, barium was not detected above cleanup levels in any of the RI samples and therefore does not appear to be a COC for FS evaluation purposes.

In addition to metals commonly associated with ammunition, 14 metals were analyzed during the RI, of which only cadmium was reported at concentrations exceeding the site-specific cleanup levels of 0.8 and 1.7 mg/kg. The reported concentrations of cadmium ranged from 0.6 to

1.9 mg/kg. According to the EPA analytical protocol (SW-846), the ICP test methodology can potentially result in a positive bias (i.e., false positive) for cadmium caused by an interference with iron. Previous investigators at the Presidio have qualified the magnitude of this positive bias in the range of 1 to 2 mg/kg (STL, 2003). That is, when using ICP to analyze for cadmium, detected values may be elevated by 1 to 2 mg/kg above actual values.

The laboratory was directed to reanalyze available RI sample extracts by EPA Method 6020 using ICP/MS, which has the potential to reduce or eliminate the interference between cadmium and iron. The laboratory had sufficient sample extracts remaining for nine of the 14 original samples that reported cadmium concentrations exceeding the cleanup levels. The ICP/MS results indicated that the cadmium concentrations are below the detection limit of 0.25 mg/kg in each of the nine samples.

Based the evaluation of the reported cadmium data, it was concluded that the initial cadmium concentrations reported did not accurately represent site conditions, the reported cadmium concentrations did not indicate cleanup level exceedances, and cadmium is not a COC (Treadwell & Rollo, 2003). Thus, antimony, copper, lead, and zinc are considered COCs for the FS.

2.1.3 Selection of Site-specific Cleanup Levels

RAOs for the SAFRs include preventing humans and ecological receptors from being exposed to unacceptable concentrations of COCs while allowing for the planned land use envisioned by the Trust and NPS. The cleanup levels for soil at the SAFRs are based on the values documented in the *Development of Presidio-wide Cleanup Levels for Soil, Sediment, Groundwater, and Surface Water* (Cleanup Levels Document) (EKI, 2002). The Trust developed the Cleanup Levels Document to facilitate a streamlined, consistent approach to cleanup levels throughout the Presidio. The cleanup levels presented in that document are based on site-specific preliminary remediation goals (PRGs) calculated for the Presidio and chemical-specific ARARs for potential contaminants of concern (PCOCs) detected in various media at the Presidio. The site-specific PRGs and chemical-specific ARARs are also compared to naturally occurring or background concentrations of metals in soil to establish cleanup levels for use at most areas of the Presidio. The Cleanup Levels Document (EKI, 2002) also provides a procedure for determining which specific cleanup levels are applicable to a given chemical release site. To determine the appropriate cleanup levels that should be applied to Presidio sites, a number of site-specific parameters, including the site lithology, future human and ecological land use, and planned water resource use at each site must be considered. This process was used in finalizing cleanup levels for the five SAFRs as part of the RI/FS process.

The steps followed in developing the initial cleanup levels for the firing ranges are summarized below.

1. Identify Site
2. Identify Media
3. Identify Predominant Lithology(ies)
4. Identify Planned Human Land Use and Applicable Cleanup Levels
5. Identify Applicable Ecological Cleanup Levels
6. Identify Whether Petroleum Hydrocarbons and Related Constituents Present
7. If Petroleum Hydrocarbons and Related Constituents Present, Identify Resources to be Protected
8. Screen Site Chemicals Based on the Most Stringent Cleanup Levels from Applicable Cleanup Tables, in accordance with the procedure provided in the Cleanup Level Document (EKI, 2002). The resulting site specific cleanup levels are presented in Tables 3 through 7.

The detection limits for the COCs were established at levels lower than the cleanup levels to ensure that the analytical methods are sufficiently sensitive to verify that detected concentrations actually exceed the cleanup levels.

The site-specific cleanup levels determined for the COCs presented in Section 2.1.2 are as follows:

- Antimony, 5.0 mg/kg;
- Copper, either 43 mg/kg or 49 mg/kg;
- Lead, 160 mg/kg; and
- Zinc, either 60 mg/kg or 66 mg/kg.

Site-specific cleanup levels are presented in Tables 3 through 7.

2.1.4 Remedial Action Summary

This section summarizes whether remedial actions are warranted at the five sites considered in this FS report.

2.1.4.1 No Further Action Sites

The RI results discussed in Section 1.2 indicated that cleanup level exceedances at LCTB, LCPR, and MGB are isolated and are bounded by samples with concentrations less than cleanup levels. The current condition at these sites indicates that they do not pose a significant threat to

human health and the environment. Therefore, no further action is recommended at the following sites (Figures 2 through 4):

- Lobos Creek Target Butt,
- Lobos Creek Protected Range, and
- Machine Gun Butt.

2.1.4.2 Remedial Action Sites

Based on the RI soil analytical results and the cleanup level exceedances discussed in Section 1.2, the following sites have been identified as requiring further action (Figures 7 and 8):

- California Highway Patrol Pistol Range, and
- Barnard Avenue Protected Range.

The remedial alternative identification and evaluation process for these two sites is discussed below.

2.2 Principal Threat and Low-level Wastes

The EPA has guidelines to communicate the types of remedial technologies generally appropriate for different source materials. Source materials include or contain contaminants that may act as a reservoir for migration of contamination to groundwater, to surface water, to air, or acts as a source for direct exposure (EKI, 2003). Source materials are divided into principal threat wastes and low-level threat wastes. The EPA defines these wastes as follows (EPA, 1991):

Principal Threat Wastes: Source materials that are considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. Principal threat wastes include non-aqueous phase liquids ("NAPLs"), highly mobile liquids (e.g., solvents), or materials having high concentrations of toxic compounds. Although no "threshold level" of toxicity has been established for definition of a principal threat waste, the EPA states that treatment alternatives generally should be evaluated for sites where toxicity and mobility of source material combine to pose a potential risk of 10^{-3} or greater.

Low-level Threat Wastes: Source materials that can be reliably contained and that would present only a low risk in the event of release or exposure. Low-level threat wastes are source materials that exhibit low toxicity, limited mobility in the environment, or have COC concentrations near health-based levels.

As discussed in Section 1.3, the COCs at the SAFRs are metals in soil that are generally present at concentrations only slightly greater than applicable cleanup levels. Consequently, source materials at the SAFRs are characterized as low-level threat wastes.

2.3 Identification and Screening of General Response Actions, Technologies, and Process Options

The purpose of this section is to identify and screen general response actions considered in this FS and identify those alternatives that will undergo a detailed analysis. Table 8 summarizes the identification and screening of general response actions, technologies and process options for soil at the Small Arms Firing Range sites. Potential remedial alternatives for addressing COCs in soil exceeding cleanup levels are organized by general response actions. General response actions are those measures that will satisfy the RAOs discussed in Section 2.1.

2.3.1 No Action

The "no action" option is included in the evaluation as a baseline for comparison of other alternatives, which is consistent with the requirements of the NCP. The "no action" alternative serves as a reference for evaluating and comparing the technical effectiveness, implementability, and cost of other alternatives. The no action alternative is viable for Small Arms Firing Range sites where COCs in soil are less than applicable cleanup levels, which are specified in Section 2.1.3. This alternative does not achieve the RAOs for the CHP and BAPR sites, however it is required to be considered by EPA and DTSC guidance. Therefore, this general response action is retained for further consideration.

2.3.2 Institutional Controls

Institutional controls are non-engineering actions designed to limit exposure to contamination left in-place or ensure effectiveness of the chosen remedy. Institutional controls are commonly referred to as land use controls and may include restrictive covenants and local restrictions. The purpose of institutional controls is to restrict disturbances to the site. A discussion of institutional controls that may be applicable to the CHP and BAPR sites is provided in this section. According to the Consent Agreement between the DTSC, Trust, and NPS, institutional controls are to be considered in an evaluation of alternatives (DTSC, 1999).

2.3.2.1 Land Use Controls

The CHP and BAPR sites are in Areas A and B, respectively. Existing and planned land uses at the CHP site are guided by requirements described in the GMPA (NPS, 1994), whereas land uses at the BAPR site are directed by the Trust through the PTMP (Trust, 2002). Land use controls for Area B sites include restricting or controlling site uses by administrative procedures such as preparing a site-specific addendum to the Presidio Trust's Land Use Control Master Reference

Report (LUCMRR). Planning/project proponents and other members of the public may review all existing LUCs for the Presidio by reviewing the LUCMRR in the Trust Library or on the Trust's web-site (www.presidiotrust.gov). This report will be submitted on 30 January 2005 and annually thereafter. The Trust would notify DTSC and RWQCB of any proposed action that may disrupt the effectiveness of the LUCs, and any proposed action that could alter or eliminate the continued need for LUCs. For Area A sites, land use controls would be implemented according to NPS Area A requirements. The Trust generally does not consider land use controls by themselves to meet RAOs for sites where contaminated materials remain left in-place and potentially exposed. Institutional controls may be used in combination with certain engineering controls (e.g., capping) that create a physical barrier between the contaminated material and human or ecological receptors. Land use controls are used to protect the engineering controls by preventing soil disturbance and exposure. Land use controls are retained for further analysis.

2.3.2.2 Monitoring

Monitoring is used in conjunction with remedial actions that leave soil containing COCs above cleanup levels in place. The purpose is to monitor for potential future impacts caused by remaining soil contamination at sites where land use controls are used.

Monitoring may include routine inspections of land use controls and caps or in conjunction with continuing soil sampling to assess the impacts of COCs on environmental conditions. Because the SAFRs COCs are relatively immobile after their initial deposition, migration to groundwater is not expected. Monitoring to ensure that land use controls and caps are maintained is retained for further consideration.

2.3.3 Containment

The EPA suggests evaluating one or more remedial alternatives that involve containment of the contaminated material with little or no treatment, but are protective of potential receptors by preventing potential exposure and/or reducing the mobility of the contaminants (EPA, 1988b). This section presents and evaluates containment or capping that would involve placing a new cap (soil with geotextile) or enhancing an existing cap (soil or asphalt) over the sites as a barrier to isolate the affected soil and prevent exposure of human and/or ecological receptors to COCs in the soil. To have long-term effectiveness, the cap would need to be maintained and intrusive activities would need to be restricted by specific institutional controls. Institutional controls would restrict the use of the site to minimize exposure to site risk as discussed above. A formal plan would be required to specify inspection frequencies and repair methods to protect the cap.

2.3.3.1 Permeable Cover

Permeable cover systems are designed to not restrict the infiltration of surface water. Permeable cover systems applicable for the site would include import and placement of clean soil on areas that are currently unpaved or asphalt sealing existing pavement sections (Table 8). Permeable covers are retained for further analysis.

2.3.3.2 Low Permeability Cover

Low-permeability cover systems are designed to minimize infiltration of surface water. Low-permeability covers include monolithic soil and geosynthetic cover systems (Table 8). Because the site contaminants are not readily transported to groundwater, low-permeability covers are not warranted. Use of a low permeability cover system is not retained for further analysis.

2.3.4 *In situ* Soil Treatment

In situ soil treatment technologies involve the reduction of the mobility or mass of COCs present in the subsurface without their removal from the site soil. *In situ* soil treatment technologies involve implementing a treatment directly into the subsurface without excavation. A discussion of the general categories of physical/chemical technologies, thermal technologies, and biological technologies is presented below.

2.3.4.1 *In situ* Soil Treatment Using Physical/Chemical Technology

Immobilization is the physical/chemical technology considered in this FS. Immobilization involves mixing chemical reagents with soil containing COCs to change the toxicity or leaching potential of the metals through solidification or stabilization. Solidification involves physically capturing the COCs within a solidified soil matrix using cement or another chemical agent. Stabilization involves using a chemical reaction to convert the COCs to a more immobile form. Land use restrictions are often required in conjunction with in situ stabilization because the contaminants are not removed. The concentrations and low mobility of metals found at CHP and BAPR do not warrant using a remedial technology which would limit future land use. *In situ* immobilization is not retained for further consideration.

2.3.4.2 *In situ* Soil Treatment Using Thermal Technology

Vitrification is the thermal technology considered in this FS. This remedial option involves using heat or electric current to melt soil and convert the soil containing metals into a vitrified mass. Availability of equipment limits implementability of vitrification (EKI, 2003). Additionally, the technology is expensive to implement and is typically used for only very toxic contaminants. Vitrification is not retained for further consideration.

2.3.4.3 *In situ* Soil Treatment Using Biological Technology

Phytoremediation is the biological technology considered in this FS. This technology involves using select plant species for contamination removal through plant uptake during growth. Plants that accumulate metals in their biomass are then removed from the site and disposed off at a permitted waste management facility. Phytoremediation is appropriate for remediating soil with low concentrations of metal contamination. However, based on the results of their phytoremediation treatability study, the Army concluded that phytoremediation is "not a viable alternative for the soil at the Presidio." Phytoremediation is not retained for further analysis.

2.3.5 Excavation

The excavation alternatives involve removing soil where COCs are present above cleanup levels. Based on information collected during the RI, the estimated volume of in-place soil that would require removal at CHP is approximately 515 cubic yards (cy) and at BAPR is approximately 1,030 cy. Excavated materials would be characterized and transported to an approved off-site disposal facility. During excavation, confirmation samples would be collected from the excavation floor and sidewalls to ensure that soils exceeding cleanup criteria have been removed. The two alternatives presented below differ with respect to treatment of ammunition fragments potentially contained within the impacted soils. A discussion of off-site disposal of soil with and without removal of ammunition fragments is presented below.

2.3.5.1 Off-site Disposal of Soil

This excavation alternative involves removing all soil where COCs are present above cleanup levels and disposing of the excavated soil off-site. The ammunition fragments, if present, would not be segregated from soil material. This alternative is retained for further analysis.

2.3.5.2 Segregation of Ammunition Fragments and Soil

Ammunition fragments were observed only at CHP and only at four of the RI sampling locations. Based on these observations, the quantity of ammunition likely to be found in excavated soil from CHP would be negligible. If significant amounts of ammunition debris are encountered during an excavation, they will be segregated and Trust and NPS archeological specialists will be notified immediately. However, encountering significant quantities of ammunition is unlikely. Therefore, this method is not retained for further analysis.

2.4 Summary of Technologies Retained for Further Consideration

General response actions, technologies and process options for soil have been evaluated to create potential alternatives for further analysis and are summarized in Table 9. Potential remedial

alternatives identified for development and screening for the Remedial Action Sites include the following:

- No Action;
- Land Use Controls;
- Capping with Permeable Cover; and
- Excavation and Off-site Disposal.

3.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

General response actions, remedial technologies and process options passing the screening of remedial technologies presented in Section 2.3 have been retained and developed into potential remedial alternatives for the CHP and BAPR.

3.1 Development of Remedial Alternatives

Using the methodology in U.S. EPA *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, 1988b), general response actions, remedial technologies, and process options for soil have been combined to create potential remedial alternatives for the Remedial Action Sites that will undergo detailed analysis (CHP and BAPR). The potential remedial alternatives are screened in their ability to achieve RAOs. A total of four potential alternatives were retained following the screening process including:

- No Action for Soil,
- Land Use Controls,
- Capping Soil with Permeable Cover, and
- Excavation and Off-Site Disposal of Soil.

3.2 Screening of Remedial Alternatives

Initial screening criteria are used to evaluate the remedial alternatives that will undergo detailed analysis for the SAFRs. For the purpose of initial screening (Table 10) and detailed analysis (Table 11a through 11d) of the remedial alternatives, both Firing Range Sites (CHP and BAPR) are evaluated together. For the comparative analysis discussed in Section 4.0, each site is analyzed separately to accommodate for different land uses and site characteristics (Table 12a and Table 12b). The screening criteria are evaluated in accordance with the National Oil and Hazardous Substances Pollution Control Plan (40 CFR Part 300). These screening criteria include technical effectiveness, implementability, and cost. A description of each of these criteria is presented below.

Screening Criteria

1. Technical Effectiveness

Technical effectiveness refers to the ability of a technology to address: 1) the estimated area or volumes of media requiring remediation and to meet the RAOs; 2) the potential impacts to human health and the environment during implementation and any construction; and 3) the long-term reliability and proven history of the technology with respect to the types of chemicals and conditions at the sites.

2. Implementability

Implementability refers to both the technical and institutional feasibility of implementing a particular remedial technology, including: 1) the likelihood of obtaining permits and approvals from regulatory agencies; 2) considerations of storage and disposal facilities; and 3) availability of the equipment, materials and skilled workers necessary to implement the particular technology.

3. Cost

Cost refers to the relative capital and operation and maintenance (O&M) costs associated with a particular technology. Costs are estimated using best engineering judgment at the time of the estimate. Cost is used to eliminate options that are substantially more expensive than other process options providing the same level of protection.

Table 10 summarizes the screening of the firing range remedial alternatives against these criteria. Screening of alternatives was conducted to eliminate remedial alternatives that cannot be applied to the sites. The results of the remedial alternatives screening are discussed in Sections 3.3 through 3.6.

3.3 No Action

The "no action" option is included in the evaluation as a baseline for comparison of other alternatives, which is consistent with the requirements of the NCP. The "no action" option serves as a reference for evaluating and comparing the technical effectiveness, implementability, and cost of other alternatives. This alternative does not achieve the RAOs for the sites; however it is retained for detailed analysis because it is required to be considered by EPA and DTSC guidance.

3.4 Land Use Controls

Land use controls would involve non-engineering practices that would limit exposure to COCs above cleanup levels left at the sites. Land use controls would include deed restrictions such as easements, restrictive covenants, and zoning ordinances. At the Presidio, legal controls such as deed restrictions or covenants cannot be put into place (EKI, 2003). The institutional controls must be compatible with the Trust's PTMP and the NPS' GMPA. The PTMP and GMPA act as zoning ordinances for land use at the Presidio. For Area B sites such as BAPR, this alternative would involve preparing a site-specific addendum to the LUCMRR for each of the remedial action sites and would have a relatively low cost. For Area A sites such as CHP, this alternative will involve preparing LUC documentation per Area A requirements. Additionally, site-specific LUCs for both Area A and Area B sites would be added to the Trust GIS system. This alternative is retained for detailed analysis.

3.5 Capping Soil

Capping would involve either placing or enhancing a cap (soil or asphalt) over the sites as a barrier to isolate the affected soil and prevent exposure to human and/or ecological receptors to chemicals in the soil. The cap would need to be maintained, and intrusive activities would need to be restricted by specific institutional controls. At both the CHP and BAPR, capping would involve asphalt sealing, importing clean fill to cover exposed soil areas, and vegetating clean fill.

Implementation of institutional controls would restrict the use of the site to minimize exposure to site risks. Institutional controls may include restrictive covenants and local restrictions. Restrictions may include limiting soil disturbances or precluding the site from residential and/or recreational use. Specific restrictions for BAPR would be identified by adding a site-specific addendum to the LUCMRR. Specific restrictions for the CHP which is located in Area A, would involve preparing LUC documentation per NPS Area A requirements Also, site-specific land use controls for both sites would be added to the Trust GIS system. Capping and institutional controls would have a low to moderate relative cost. This option is retained for further detailed analysis.

3.6 Soil Excavation and Off-Site Disposal

Excavation is a practical source control measure that would be applicable to the conditions at the sites. Excavation involves removal of the contaminated soil, confirmation sampling, waste disposal characterization, waste transport and disposal, and site stabilization and vegetation replacement activities. This alternative is consistent with the proposed future land use for the sites. Off-site disposal moves hazardous material from its current location to an approved off-site disposal facility. This alternative would not restrict land use since COCs would be removed from the soil. At CHP, special consideration would be required for performing excavation activities near the historic battery. This alternative would have a moderate relative cost. This option is retained for further evaluation.

3.7 Summary of Remedial Action Alternatives Developed for Detailed Analysis

Based on the screening level evaluation described above, the following remedial alternatives have been developed for detailed analysis for the both the CHP and BAPR.

- Alternative 1 – No Action
- Alternative 2 – Land Use Controls
- Alternative 3 –Capping Soil with Permeable Cover
- Alternative 4 – Excavation and Off-site Disposal of Soil

4.0 DETAILED ANALYSIS OF ALTERNATIVES

The remedial alternatives retained for analysis for the CHP and BAPR sites were developed and screened in Section 3.0. The NCP requires conducting a detailed analysis of the alternatives developed to identify the preferred remedial alternative for each remedial action site. The detailed analysis of each remedial alternative is based on specified criteria. The nine NCP criteria include two threshold, five balancing, and two modifying criteria. For a remedial alternative to be considered an appropriate remedial action, it must meet both threshold criteria. Balancing criteria act as an opportunity to identify and evaluate strengths and weakness and cost-effectiveness of an alternative. Modifying criteria are evaluated after stakeholder comments on the RI/FS are received.

The detailed analysis for each remedial alternative for both the CHP and BAPR sites are summarized in Tables 11a through 11d, respectively. The comparative evaluation of alternatives summary for the CHP and BAPR sites are presented in Tables 12a and 12b, respectively. A summary of estimated costs for each alternative evaluated is presented in Table 13. Tables C-1 through C-6 in Appendix C provide the estimated costs for each remedial alternative.

Threshold Criteria

1. Overall Protection of Human Health and the Environment

This criterion addresses whether or not a remedy provides adequate protection and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

2. Compliance with ARARs

Addresses whether or not a remedy will meet applicable or relevant and appropriate Federal, State and local environmental laws and regulations identified in Table 2.

Balancing Criteria

3. Long-term Effectiveness and Permanence

Considers the ability of a remedy to provide reliable protection of human health and the environment over time after cleanup goals have been achieved.

4. Reduction of Toxicity, Mobility and Volume (TMV) Through Treatment

Reflects the bias for treatment of contaminants by evaluating the anticipated performance of the alternative with respect to the reduction of toxicity, mobility, and volume of contaminants.

5. Short-term Effectiveness

Evaluates the period of time needed to complete the remedy, and any negative impact on human health and the environment that may be posed during remedy construction and implementation, until cleanup standards are achieved.

6. Implementability

Refers to the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a remedial option.

7. Cost

Evaluates the capital and O&M costs of each alternative. Typically, preliminary cost estimates of this type for an FS are considered accurate within a range that may vary as much as 30 percent less to 50 percent more than the estimated cost. Some of the reasons for this range are the variability of construction materials, variability in construction costs over time, the complexity of developing site-specific cost factors, and the sensitivity of construction costs to economic factors such as interest rates and materials costs.

Modifying Criteria

8. Regulatory Agency Acceptance

Indicates whether, based on its review of the information, the applicable regulatory agencies agree with the preferred alternative.

9. Community Acceptance

This criterion assesses whether community concerns have been addressed by the remedial action and whether or not the community has a remedial action preference. The future RAP will be subject to public review and comment prior to the final selection of the remedial action alternative.

Additional Criteria

The California Health and Safety Code (HSC) requires that alternatives be evaluated relative to the following six additional criteria.

1. Health and safety risks posed by the site conditions.

2. The effect of COCs present on probable present and future uses of contaminated or threatened resources.

3. The effect on available groundwater resources for present, future, and probable beneficial uses. Treatment that reduces the volume, toxicity, and mobility of contaminants as opposed to alternatives that use off-site transport and disposal are preferred.

4. Site-specific conditions (potential for off-site migration) and existing contaminant background levels.

5. Cost-effectiveness, considering the short-term and long-term costs of the remedial action and whether deferral of a remedial action could result in a cost increase or hazard increase to human health or the environment.

6. The potential environmental impacts of the remedial alternative such as land disposal of contaminated material versus treatment to remove or reduce its volume, toxicity, or mobility prior to disposal.

The six HSC criteria are similar to and covered under the nine NCP criteria, but for this FS, will be considered as additional criteria.

4.1 Comparative Analysis of Remedial Alternatives for CHP

The comparative alternatives evaluation summary for CHP is summarized in Table 12a and discussed below. Estimated costs are summarized in Table 13.

4.1.1 Alternative 1 – "No Action"

Because the shallow soil contamination is not removed this alternative would not be protective of human health and the environment, and is not anticipated to comply with ARARs. The "no action" alternative would not meet the balancing criteria because it will not provide long-term protection from contaminants, does not reduce TMV, and does not protect park visitors or maintenance workers from short-term risks. The "no action" alternative would be readily implementable and has no cost associated with its implementation. However, neither the State nor Community is likely to accept the "no action" alternative as a remedial option because this alternative does not address the health and safety risks posed by the site. The "no action" alternative is not recommended.

4.1.2 Alternative 2 – Land Use Controls

This alternative would not be protective of human health and the environment, and it is not anticipated to comply with ARARs because the soil containing COCs remains in-place. Furthermore, this alternative does not meet the balancing criteria of long-term effectiveness and permanence, reduction of TMV, or short-term effectiveness. LUCs are readily implementable, but require long term maintenance and monitoring. Because soil containing COCs is not

removed it is unlikely that the Regional Water Quality Control Board (RWQCB) or DTSC will find this alternative acceptable. In addition, the RAB and members of the community would likely prefer an alternative that does not require long term maintenance or monitoring. LUCs would address some of the human health and environmental risks posed by the site. Although the cost to implement this alternative at both CHP and BAPR is comparatively lower ($201,000), it may not be protective of human health and the environment and is unlikely to receive Agency approval. This alternative is not recommended.

4.1.3 Alternative 3 – Capping Soil with Permeable Cover

Alternative 3 includes maintaining the existing asphalt cover over a portion of the soil containing COCs and placing permeable soil caps over uncovered soil containing COCs to isolate the contaminated soil from human exposure. This alternative includes the development and implementation of LUCs. LUCs would be implemented to safeguard the cap, provide advance notice of a potential threat in the event of future ground disturbing activity, and restrict future land uses to those compatible with safeguarding the integrity of the cap.

Capping of contaminants would be protective of human health and the environment as it would eliminate the potential exposure pathway for soil ingestion, dermal contact, and fugitive dust inhalation. Institutional controls would also be required to prevent direct contact with the contaminated soil remaining on site. Capping and restricted use may not comply with certain ARARs. Therefore, this alternative does not meet one of the two "threshold criteria" required for a preferred alternative. This alternative would meet the long-term permanence and effectiveness criteria provided that the caps are maintained and land use controls imposed. Although this alternative reduces the likelihood of human or ecological exposures to COCs remaining on site, it does not eliminate them. The overall toxicity and volume of the soil containing COCs would not be reduced. This alternative poses less short-term human health exposures for workers and visitors than the excavation alternative (Alternative 4) because the soil will be largely undisturbed.

All remediation activities located within Area B (BAPR) of the Presidio are submitted to the Trust multidisciplinary NHPA review/management team for review and approval to ensure compliance with Section 106 of the NHPA. Sites located within Area A (CHP) will, in addition to the Trust NHPA review, undergo review and comment by the NPS NHPA management team and remedial design efforts must be coordinated with the NPS Section 106 consultation team.

Capping may not be readily implementable at CHP because a portion of the impacted soil is on top of the historic battery and the associated earthworks and road are also historic features. It would be difficult to construct a permanent cap on the battery without damaging or affecting the appearance of these historic features, including the battery. Cap implementation will be difficult due to current land use and the historic battery.

Capping may be protective of human health and the environment. The RWQCB and DTSC may consider this alternative acceptable, provided a waiver of the unattainable ARARs could be obtained. However, the RAB may prefer an alternative that removes the contamination (i.e. excavation and off-site disposal). The estimated cost for this alternative ($364,000) is more than the cost of the excavation alternative (Section 4.1.4) and capping is not recommended.

4.1.4 Alternative 4 – Soil Excavation and Off-Site Disposal

This alternative would be more protective of human health and the environment than other alternatives because the soil contamination is removed, thereby eliminating human and ecological exposures. The excavated soil would be removed and transported to a facility designed to manage the waste. This alternative would comply with all ARARs. Therefore, this alternative meets the two "threshold criteria". This remedy would provide long-term effectiveness and permanence. Contaminated soil is removed, thereby preventing potential future worker and visitor exposures and impacts to groundwater. The volume of hazardous material would be removed from the CHP, but would not be reduced because it would be transferred to an off-site landfill. Toxicity and mobility would not be reduced, because the impacted material is not likely to be treated. Potential exposure of workers and the public to contaminated materials during excavation and loading for off-site transport would be mitigated by engineering and dust control measures.

All remediation activities located within Area B (BAPR) of the Presidio are submitted to the Trust multidisciplinary NHPA review/management team for review and approval to ensure compliance with Section 106 of the NHPA. Sites located within Area A (CHP) will, in addition to the Trust NHPA review, undergo review and comment by the NPS NHPA management team and remedial design efforts must be coordinated with the NPS Section 106 consultation team.

Although some construction and design efforts will be needed to move the contaminated soil, especially in the vicinity of the historic battery and earthworks, this method is implementable. Excavation with off-site disposal at other sites in the Presidio has been approved by the RAB. This alternative is less expensive ($240,000) than Alternative 3 and will be the most protective of human health and the environment in the long-term. This alternative is recommended as the preferred remedy for the CHP.

4.2 Comparative Analysis of Remedial Alternatives for BAPR

The comparative alternatives evaluation summary for BAPR is summarized in Table 12b and discussed below. Estimated costs are summarized in Table 13.

4.2.1 Alternative 1 – "No Action"

Because the shallow soil contamination is not removed this alternative would not be protective of human health and the environment, and it is not anticipated to comply with ARARs. The "no action" alternative would not meet the balancing criteria because it will not provide long-term protection from contaminants, does not reduce TMV, and does not protect park visitors or maintenance workers from short-term risks. The "no action" alternative would be readily implementable and has no cost associated with its implementation. However, neither the State nor Community are likely to accept the "no action" alternative as a remedial option because this alternative does not address the health and safety risks posed by the site. The "no action" alternative is not recommended.

4.2.2 Alternative 2 – Land Use Controls

This alternative would not be protective of human health and the environment, and it is not anticipated to comply with ARARs because the soil containing COCs remains in-place. Furthermore, this alternative does not meet the balancing criteria of long-term effectiveness and permanence, reduction of TMV or short-term effectiveness. LUCs are readily implementable but require long term maintenance and monitoring. Because soil containing COCs is not removed, it is unlikely that RWQCB or DTSC will find this alternative acceptable. In addition, the RAB and members of the community would likely prefer an alternative that does not require long term maintenance or monitoring. LUCs would address some of the human health and environmental risks posed by the site. Although the cost to implement this alternative at CHP and BAPR is comparatively lower ($201,000), it may not be protective of human health and the environment and is unlikely to receive Agency approval. This alternative is not recommended.

4.2.3 Alternative 3 – Capping Soil with Permeable Cover

Alternative 3 includes maintaining the existing asphalt cover over a portion of the soil containing COCs and placing caps over uncovered soil containing COCs to isolate the contaminated soil from human exposure. This alternative includes the development and implementation of land use controls. Land use controls would be implemented to safeguard the cap, provide advance notice of a potential threat in the event of future ground disturbing activity, and restrict future land uses to those compatible with safeguarding the integrity of the cap.

Capping of contaminants would be protective of human health and the environment as it would eliminate the potential exposure pathway for soil ingestion, dermal contact, and fugitive dust inhalation. Institutional controls would also be required to prevent direct contact with the contaminated soil remaining on site. Capping and restricted use may not comply with certain ARARs. Therefore, this alternative does not meet one of the two "threshold criteria" required for a preferred alternative. This alternative would meet the long-term permanence and effectiveness criteria provided that the caps are monitored and land use controls imposed.

Although this alternative reduces the likelihood of human or ecological exposures to COCs remaining on site, it does not eliminate them. The overall toxicity and volume of the soil containing COCs would not be reduced. This alternative poses less short-term human health exposures for workers and visitors than the excavation alternative (Alternative 4) because the soil will be largely undisturbed.

Capping may be implementable at BAPR. A section of the BAPR is already capped with asphalt, concrete, and existing structures (Buildings 808 and 809). This pre-existing cap could be maintained, however Buildings 808 and 809 are scheduled to be removed in the future as part of planned restoration activities associated with the Tennessee Hollow riparian corridor. Institutional controls would therefore be needed to account for this change. For instance, following demolition and removal of the structures, confirmation sampling of the exposed soils would be required to ascertain whether further remedial action is warranted. The RWQCB and DTSC may consider this alternative acceptable, provided a waiver of the unattainable ARARs could be obtained. However, the RAB may prefer an alternative that removes the contamination (i.e. excavation and off-site disposal). The estimated cost for this alternative ($319,000) is more than the cost of the excavation alternative and although capping may be protective of human health and the environment, it is not recommended.

4.2.4 Alternative 4 – Soil Excavation and Off-Site Disposal

This alternative would be more protective of human health and the environment than other alternatives because the soil contamination is removed, thereby eliminating human and ecological exposures. The excavated soil would be removed and transported to a facility designed to manage the waste. Because Buildings 808 and 809 will be removed in the future, Alternative 4 includes the development and implementation of land use controls (LUCs). Where COCs are present in soil above the cleanup levels, LUCs will be required for areas that are currently inaccessible (covered with pavement and/or buildings), or where removal of impacted soil would undermine the foundation of the building. LUCs will be implemented to safeguard the existing soil cover, provide advance notice of a potential threat in the event of future ground disturbing activity, and restrict future land uses to those compatible with safeguarding the integrity of the cover until building demolition and proper removal and handling of contaminated soil are implemented. This alternative would comply with ARARs. Therefore, this alternative meets the two “threshold criteria”. This remedy would provide long-term effectiveness and permanence. Contaminated soil is removed, thereby preventing potential future worker and visitor exposures and impacts to groundwater. The volume of hazardous material would be reduced because the impacted fill materials and soil would be segregated from the inert materials. Toxicity and mobility would not be reduced, since the impacted material is not likely to require treatment. Potential exposure of workers and the public to contaminated materials during excavation and loading for off-site transport would be mitigated by engineering and dust control measures. Although some construction and design efforts will be needed to move the contaminated soil, this method is implementable. Excavation with off-site disposal at

other sites in the Presidio has been approved by the RAB. This alternative is less expensive ($244,000) than Alternative 3 and will be the most protective of human health and the environment in the long-term. This alternative is recommended as the preferred remedy for the BAPR.

5.0 RECOMMENDED REMEDIAL ALTERNATIVES

This FS reviewed site-specific conditions at five SAFRs with respect to potential remedial actions. The FS identified and developed remedial action alternatives; then through screening process guidance, reduced the number of potential remedial actions for a more detailed evaluation. This evaluation process resulted in recommended remedial alternatives for each of the five SAFRs.

Three of the sites, Lobos Creek Target Butt, Lobos Creek Protected Range, and Machine Gun Butt are recommended for No Action. Based on the RI results, conditions at these three sites do not warrant additional investigation or remedial action. Based on site conditions and the RI, the remaining sites (CHP and BAPR) warrant remedial action.

The preferred remedial action at CHP includes the excavation and off-site disposal of soil exceeding site-specific cleanup levels. As shown on Figure 7, soil will be excavated from six areas. The excavated soil will be characterized and transported off-site for disposal. Clean soil material will be imported and backfilled into the soil excavations. The ground surface will be restored to its pre-excavation condition.

For the BAPR site, the preferred remedial action will include excavation and off-site disposal with land use controls to cover potentially impacted soil that is currently inaccessible until Building 808 and 809 are demolished. As shown on Figure 8, there are four areas where soil contamination exceeds site-specific cleanup goals. Soil from these areas will be excavated, characterized, and transported off-site for disposal. Clean soil material will be imported and backfilled into the soil excavations. The ground surface will be restored to its pre-excavation condition.

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TABLES

Table 1
Historical Summary of Small Arms Firing Range Activities
Small Arms Firing Ranges
Presidio of San Francisco, California

Location	Date of Maps Where Location Shown	Date of Map Where Firing Range First Not Shown	Approximate Dates in Use	Area Regraded?	Approximate Troop Numbers	Likelihood of Encountering Projectiles[1]
Lobos Creek Target Butt	1907[2], 1910[2], 1915	1916	1896[2] to 1902[2]	No [3]	1,000	Moderate
Lobos Creek Protected Range	1907, 1910	1912	1902[2]-1910	Yes (1998 dune restoration)	1,000	Low
Machine Gun Butt (southeast of Bldg. 637)	1939, 1942	1943	Late 1930s to early 1940s	Partially (1993 tank and soil removal)	3,000	Moderate
CHP Pistol Range	1949, 1959, 1961, 1962	1964	1944 to 1960s[2]	Yes	3,000-4,000	High
Barnard Avenue Protected Target Range	1907[2], 1909, 1910, 1921	1928	1907[2] to mid-1920s[2]	Yes (Partially filled in as Landfill E)	1,000-2,000	Low

Notes

[1] Likelihood of encountering projectiles is based on the years of range operation, the approximate troop numbers for the given period of range operation, and regrading activities at the former firing ranges.

[2] *Archive Search Report, Presidio of San Francisco*. (U.S. Army Corps of Engineers, 2003).

[3] Portion of target butts made of dune deposit may have been blown away by wind.

From *Site-Specific Work Plan for Environmental Soil Investigation of the Small Arms Firing Ranges* (Montgomery Watson, 1996), unless otherwise noted.

Table 2
Applicable or Relevant and Appropriate Requirements (ARARs)
Small Arms Firing Ranges
Presidio of San Francisco, California

ARAR or TBC	Citation or Authority	Type	Location	Description
Chemical-Specific ARARs and TBCs				
Federal ARARs and TBCs				
• Residential Lead-Based Paint Hazard Reduction Act of 1992 (Title X of TSCA)	15 U.S.C. §2681,2683, and 2688; 40 Code of Federal Regulations (CFR) Section 745.65(c) and 745.227(h)(4) .	Relevant and appropriate	Barnard Avenue Protected Range (BAPR) and California Highway Patrol Pistol Range (CHP)	66 Fed. Reg. 1206, 1238 (5 January 2001) revised 40 CFR Part 745 to establish a hazard standard of 400 mg/kg lead in bare soil at residential sites and child-occupied facility sites.
• U.S. EPA Office of Solid Waste and Emergency Response (OSWER) Lead Guidance	OSWER Directive #9355.4-12 (Revised Interim Soil Lead Guidance for CERCLA sites and RCRA Corrective Action Facilities, July 1994); OSWER #9200.4-27P (Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, August 27, 1998)	To be considered	BAPR and CHP	Outlines approach to determining protective levels for lead in soils at CERCLA sites and identifies 400 ppm as screening level for lead in soil for residential land use.
State ARARs and TBCs				
• DTSC Lead Spread Computer Model Version 7.0		To be considered	BAPR and CHP	A State of California computer model which calculates preliminary remediation goals for lead in soil based on DTSC default factors and exposure assumptions based on planned land-use at the San Francisco Presidio.
Location-Specific ARARs and TBCs				
Federal ARARs and TBCs				
• National Historic Preservation Act (NHPA)	16 USC §§ 470–470x-6; 36 CFR §§ 800.1–.16, 60.2 (effect of listing in National Register), 65.2 (effect of designation as National Historic Landmark), 68.1–.4 (Dept. of Interior [DOI] standards for historic property projects assisted by the National Historic Preservation Fund).	Applicable	BAPR and CHP	This Act is applicable to the entire Presidio, since it is designated in the National Register as a historic landmark. The California Highway Patrol Pistol Range (CHP) contains a known historic resource (historical battery) which will be encountered during excavation.

Table 2
Applicable or Relevant and Appropriate Requirements (ARARs)
Small Arms Firing Ranges
Presidio of San Francisco, California

ARAR or TBC	Citation or Authority	Type	Location	Description
• Archeological Resources Protection Act (ARPA)	16 USC §§ 470aa–470mm; 43 CFR §§ 7.1–.37 (DOI regulations for protection of archeological and historical resources)	Applicable	BAPR and CHP	ARPA prohibits excavation of, damage to, or destruction of archeological resources on public lands without a permit issued by the federal land manager.
• Federal Endangered Species Act (ESA)	16 USC §§ 1531(c)(1); 1532; 1533(d); 1536(a)–(d), (g), (h); 1538(a)(1)(B), (a)(1)(G), (a)(2)(B), (a)(2)(E); 1539(a), (c), (d); 1540(a)–(c); 50 CFR §§ 11.1–11.26, 13.1–13.29, 402.01–402.16, 424.01–424.21.	Applicable	BAPR and CHP	Under the ESA, federal agencies must make sure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or cause the destruction or adverse modification of their habitat. Four federal endangered bird species have been recorded as casual visitors to the Presidio and vicinity: American peregrine falcon, bald eagle, California brown pelican, and snowy plover. Five federal endangered plant species have been identified at various locations at the Presidio: Raven's manzanita, Presidio clarkia, Marin dwarf flax, San Francisco lessingia, and California seablight.
• Archeological and Historic Preservation Act (AHPA)	16 USC §§ 469–469c-2; 43 CFR §§ 7.1-3.7 (DOI regulations for protection of archeological and historic resources)	Applicable	BAPR and CHP	AHPA requires federal agencies, prior to engaging in activities that could cause irreparable loss of scientific, prehistorical, historical, or archeological data, to notify the Secretary of the Interior of the threatened data and the proposed activities, and to preserve the data or request that the Secretary do so. The DOI must conduct a survey and recovery effort if it finds the data are significant and may be irrevocably lost without such action.
• Native American Graves Protection and Repatriation Act (NAGPRA)	25 USC §§ 3001-3013; 43 CFR §§ 10.1-.17	Applicable	BAPR and CHP	NAGPRA establishes a system for determining ownership and proper disposal/removal of Native American cultural items discovered in federal lands and requires inventorying and identification of those items. Such items must be returned to the relevant tribe.

Table 2
Applicable or Relevant and Appropriate Requirements (ARARs)
Small Arms Firing Ranges
Presidio of San Francisco, California

ARAR or TBC	Citation or Authority	Type	Location	Description
• Migratory Bird Treaty Act	16 USC §§ 703–708; 50 CFR §§ 10.12, 10.13.	Applicable	BAPR and CHP	The Act prohibits the taking of migratory birds, their nests and their eggs, unless permitted by the Secretary of the Interior. Migratory birds have been observed at the Presidio.
• Presidio Trust Act	The Presidio Trust Act, Section 104(a) of Public Law 104-333 as amended; 16 U.S.C §460bb appendix.	Applicable	BAPR	The Trust shall manage the leasing, maintenance, rehabilitation, repair, and improvement of property within the Presidio under its administrative jurisdiction using the authorities provided in this section, which shall be exercised in accordance with the purposes set forth in Section 1 of the act, entitled "An Act to establish the Golden Gate National Recreation Area in the State of California, and for other purposes," approved 27 October 1972 (Public Law 92-589; 86 Stat. 1299; 16 USC 460bb), and in accordance with the general objectives of the General Management Plan for the Presidio. Resolution 99-11 of the Presidio Trust Act sets forth the general objectives which are not explicit in the General Management Plan Amendment.
• National Park Service Organic Act	16 USC §§ 1 et seq.	Applicable	CHP	The National Park Service (NPS) Organic Act is intended to protect park resources and to provide for the enjoyment of those resources in a manner that will leave them unimpaired for future generations. The NPS retains administrative jurisdiction over Area A; therefore, the NPS Organic Act applies to Area A. More specifically, Section 19jj states that a person who destroys, causes the loss of, or injures any park system resource is liable to the U.S. for response costs and damages.
• Golden Gate National Recreation Area (GGNRA) Act	16 USC § 460bb–460bb-5	Applicable	BAPR (Section 1, Purpose) and CHP (entire Act)	The entire Act is applicable to Area A. Among the purposes stated in Section 1 of the GGNRA Act are to preserve the recreation area, to the degree possible, in its natural setting, and protect it from development and uses that would destroy the scenic beauty and natural character of the area. These purposes are applicable to Area B under the Presidio Trust Act. The Presidio is part of the GGNRA.

Table 2
Applicable or Relevant and Appropriate Requirements (ARARs)
Small Arms Firing Ranges
Presidio of San Francisco, California

ARAR or TBC	Citation or Authority	Type	Location	Description
• National Park Service Management Policies 2001	Sections 4.4.1 (General Principles for Managing Biological Resources), 4.4.1.2 (Genetic Resource Management Principles), 4.4.2.2 (Restoration of Native Plant and Animal Species), 4.4.2.4 (Management of Natural Landscapes), 4.4.2.5 (Maintenance of Altered Plant Communities), 4.4.4 (Management of Exotic Species), 4.4.4.2 (Removal of Exotic Species Already Present)	To be considered	BAPR and CHP	The NPS management policies contain Natural Resource Management preservation policies aimed at maintaining park natural resources in an unimpaired condition.
• General Management Plan Amendment (GMPA)	*National Park Service, Creating a Park for the 21st Century, from Military Post to National Park* (NPS, 1994).	To be considered	CHP	The GMPA provides the overall land use plan for the Presidio.
• Presidio Trust Management Plan (PTMP)	Presidio Trust Management Plan, Land Use Policies for Area B of the Presidio of San Francisco, California.	To be considered	BAPR	The PTMP provides guidelines for the management and improvement of Area B of the Presidio.
• Vegetation Management Plan (VMP)	Presidio of San Francisco Vegetation Management Plan and Environmental Assessment, (Trust and NPS 2001).	To be considered	BAPR and CHP	The VMP guides the management of vegetative resources within the Presidio, including the enhancing, restoring and rehabilitating of native and planted vegetation at the Presidio. The VMP establishes the vegetative schemes for the Presidio.
• Memorandum of Agreement between the Presidio Trust and NPS (Area A MOA)	The Memorandum of Agreement for Environmental Remediation of Presidio of San Francisco "Area A" Property, Sections 4, 5, and 6.1.	To be considered.	CHP	With certain exceptions, the Trust assumed responsibility for remediation of both Areas A and B of the Presidio by signing the Presidio Memorandum of Agreement (MOA) between the Trust, the Dept. of the Army, and the DOI, and the Area A MOA between the Trust and DOI. Section 4 of the Area A MOA, Remedial Action Selection, sets forth standards for selection of final remedial actions. Section 5 of the Area A MOA guides the Presidio

Table 2
Applicable or Relevant and Appropriate Requirements (ARARs)
Small Arms Firing Ranges
Presidio of San Francisco, California

ARAR or TBC	Citation or Authority	Type	Location	Description
				Trust's design and implementation of remedial actions. Section 6.1 guides the Presidio Trust's operation and maintenance and closure requirements.
• Federal wetlands regulations	Executive Order 11990; 40 CFR § 6.302(a), (d), and (g)	Relevant and appropriate	BAPR	Executive Order 11990 and 40 CFR §§ 6.302(a) require federal agencies conducting certain activities to avoid, to the extend possible, the adverse impacts associated with the destruction or loss of wetlands. U.S. EPA must determine whether the proposed actions will affect wetlands, and if so, the responsible agency must perform a wetlands assessment. In addition, if coastal zone resources would be significantly affected, the EPA must seek a determination of consistency with the local coastal program (here, BCDC's San Francisco Bay Plan). Adverse impacts shall be either avoided or, if no practicable alternative to the action exists, minimized.
• NPS Programmatic Agreement	The Programmatic Agreement for the Presidio between the NPS and the State Historic Preservation Officer ("SHPO"), dated August 31, 1994.	To be considered	CHP	The Programmatic Agreement for the Presidio between the NPS and the State Historic Preservation Officer (SHPO), dated August 31, 1994, states that the Presidio of San Francisco shall manage and preserve its historic properties consistent with good historic preservation management and stewardship. This NPS/SHPO Programmatic Agreement is pertinent to Area A.
• Clean Water Act (CWA)	33 USC §1344; 33 CFR §323, 320-330; 40 CFR 230, 232	Applicable	BAPR	The procedural permit requirement is not applicable to on-site remedial action. However, the substantive requirements of Sections 401 and 404 of the CWA apply to remedial actions affecting wetlands at the Presidio. There are wetlands within the zones of planned remedial actions at BAPR. The remedial activities at this site will avoid destruction, loss, or adverse impacts to wetlands to the extent possible.

Table 2
Applicable or Relevant and Appropriate Requirements (ARARs)
Small Arms Firing Ranges
Presidio of San Francisco, California

ARAR or TBC	Citation or Authority	Type	Location	Description
State ARARs and TBCs				
• Basin Plan - Chapter 4 – Pages 4-49 to 4-51, Wetlands Protection Management	Porter-Cologne Water Quality Control Act promulgated under California Water Code, § 13240-13241, Basin Plan, pp. 4-49 to 4-51	Applicable	BAPR	The Basin Plan reaffirms the goal of the California Wetlands Conservation Policy of ensuring no net loss of wetlands.
• State wetlands policy	California Fish & Game Commission's Wetlands Policy	To be considered	BAPR	The California Fish & Game Commission's wetlands policy instructs the Dept. of Fish & Game to recommend protection, preservation, restoration, enhancement and expansion of wetlands when the Dept. of Fish & Game acts in an advisory role. The Commission's wetlands policy is not a promulgated regulation. The Trust and NPS have mapped the Presidio wetlands.
• California Endangered Species Act (CESA); wildlife protection statute	Cal. Fish & Game Code §§ 1908, 2053–2054, 2081, 2080.1, 2081.1; 14 CCR §§ 670.2, 670.5, 783.1-783.6; Cal. Fish & Game Code § 2014.	Applicable	BAPR and CHP	Similar to the federal ESA, the California ESA prohibits taking of endangered or threatened species, unless an incidental take permit is obtained. Calif. Fish & Game Code section 2014 prohibits willful or negligent taking or destruction of any bird, mammal, fish, reptile, or amphibian protected by State laws.
• California Native Plant Protection Act	Cal. Fish & Game Code § 1908; 14 CCR §§ 783.1-783.6	Applicable	BAPR and CHP	The California Native Plan Protection Act prohibits the taking of endangered or rare native plants, unless authorized by an incidental take permit. Six California endangered plant species have been identified at the Presidio: San Francisco spineflower, Franciscan thistle, dune gilia, San Francisco gum plant, San Francisco campion, and San Francisco owl's clover.
• Cal. Fish & Game Code regarding protection of birds, mammals, reptiles, or amphibia	Cal. Fish & Game Code §§ 3503, 3503.5, 3511, 3513; 14 CCR § 747	Applicable	BAPR and CHP	The California Fish & Game Code prohibits taking, possessing, or destroying certain birds, their nests, and their eggs. Migratory and other birds have been observed at the Presidio. Remedial actions that include removal of trees that may provide nests for migratory birds may require additional review. One California endangered bird species, the willow flycatcher, has been identified at the Presidio.

Table 2
Applicable or Relevant and Appropriate Requirements (ARARs)
Small Arms Firing Ranges
Presidio of San Francisco, California

ARAR or TBC	Citation or Authority	Type	Location	Description
Action-Specific ARARs and TBCs				
Federal ARARs and TBCs: None				
State ARARs and TBCs				
• California Fish & Game Code regarding protection of wildlife during stream realignment	Cal. Fish & Game Code §§ 1601, 1603	Relevant and appropriate	BAPR	If stream realignment or modification is proposed or authorized by a Federal agency in an area not under its land management authority, then 16 USC section 662(a) requires that the Federal agency consult with U.S. Fish and Wildlife Service and the DOI to prevent loss or damage to wildlife as a result of the project. If a remedial action realigns or modifies a stream, the Trust may be required to consult with these agencies. Under 16 USC section 662(h), the Trust's remediation activities in Area B are exempt from the consultation requirement.
• Basin Plan-- Chapter 4,: Effluent Limitations	Porter-Cologne Water Quality Control Act promulgated under California Water Code §13240-13241, Basin Plan, pages 4-8 to 4-11	Applicable	BAPR and CHP	Limitations to construction-related stormwater discharges are described in this provision.
Discharge of Treated Groundwater Table 4-1: Discharge Prohibitions	Porter-Cologne Water Quality Control Act promulgated under California Water Code § 13240-13241, Basin Plan, pp. 4-17 to 4-18; Table 4-1	Applicable	BAPR and CHP	Table 4-1 more broadly describes discharge prohibitions (e.g., with respect to toxic substances, solid wastes, silt, sediments, oil, and petroleum by-products). Page 4-17 of the Basin Plan refers to State Water Quality Control Board (SWRCB) Resolution No. 88-160, Disposal of Extracted Groundwater from Cleanup Projects, which urges dischargers of groundwater extracted from site clean-up projects to reclaim their effluent. It states that when reclamation is not feasible, discharges must be piped to a municipal treatment plant or discharged under a National Pollutant Discharge Elimination System (NPDES) permit authorizing the discharge from these sites.

Table 2
Applicable or Relevant and Appropriate Requirements (ARARs)
Small Arms Firing Ranges
Presidio of San Francisco, California

ARAR or TBC	Citation or Authority	Type	Location	Description
Stormwater Discharges	Porter-Cologne Water Quality Control Act promulgated under California Water Code § 13240-13241, Basin Plan pp. 4-14 to 4-15	Applicable	BAPR and CHP	The Stormwater Discharges program is regulated by the Regional Board for certain municipal, industrial, and construction stormwater discharges through NPDES permits. NPDES permits include requirements to prevent or reduce discharges of pollutants that cause or contribute to violations of water quality objectives.
Wetlands Protection and Management	Porter-Cologne Water Quality Control Act promulgated under California Water Code § 13240-13241, Basin Plan pp. 4-49 to 4-51	Applicable	BAPR	The Basin Plan reaffirms the goal of the California Wetlands Conservation Policy of ensuring no overall net loss of wetlands.
Surface Water Protection	Porter-Cologne Water Quality Control Act promulgated under California Water Code § 13240-13241, Basin Plan pp. 4-28, 4-32, 4-40 to 4-41	Relevant and appropriate	BAPR and CHP	Surface Water Protection and Management through nonpoint source control is regulated by the RWQCB. The Construction Activity Control Program requires an NPDES permit for construction activities involving disturbance of one acres or greater total land area. Permit conditions address pollutant and waste discharges occurring during construction activities and the discharge of pollutants in runoff after construction. The Erosion and Sediment Control program establishes guidelines for the regulation of erosion and sedimentation for the protection of beneficial uses of water due to the impairment by sediment.
Cleanup of Polluted Sites	Porter-Cologne Water Quality Control Act promulgated under California Water Code § 13240-13241, Basin Plan, pp. 4-17 to 4-18; Table 4-1, pp. 4-58 to 4-59 and 4-62 to 4-63	Applicable	BAPR and CHP	pp. 4-58 to 4-59 discuss the Regional Board's strategies for setting groundwater and soil cleanup levels.
• State Water Resources Control Board (SWRCB) Resolution No. 92-49	Porter-Cologne Water Quality Control Act promulgated under California Water Code, Section 13140	Relevant and appropriate	BAPR and CHP	Resolution 92-49 establishes policies and procedures for investigating and remediating chemical releases that affect or threaten water quality.

Table 2
Applicable or Relevant and Appropriate Requirements (ARARs)
Small Arms Firing Ranges
Presidio of San Francisco, California

ARAR or TBC	Citation or Authority	Type	Location	Description
• Hazardous Waste Requirements-- Generation, Transport, and Disposal Regulations	State of California citation: Cal. Health & Safety Code §§ 25100–25249, 25250–25250.26, 25260–25929; 22 CCR §§ 66260.1–68500.35. Federal citation: 42 USC §§ 6901–6991i; 40 CFR Parts 260–282. §§ 25100-25166.5, 25179.1–.12 (land disposal restrictions [LDRs]), 25244–25244.24 (waste reduction and recycling); 22 CCR §§ 66260.10–66262.41, 66264.1–.172, 66265.16–199; 66268.10–.44, .105–113 (LDRs + treatment standards); 49 CFR Parts 172, 173, 178, 179 (transportation) [incorporated by reference]	Applicable	BAPR and CHP	Pursuant to 42 USC § 7926, the State of California is authorized to implement the federal Resource Conservation and Recovery Act (RCRA) Program. Federal statutes may apply to areas not covered by the state program, or where incorporated by reference. SAFRs remedial action may include off-site transportation and disposal of hazardous wastes.
• Medical Waste Handling Requirements	Cal. Health and Safety Code 117600-118360; SF Municipal Health Code §§ 1501-1514	Relevant and appropriate	BAPR and CHP	Medical waste is required to undergo certain treatment requirements prior to disposal so that it can be characterized as a "solid" waste. Without such treatment, land disposal of medical waste is not permitted.
• Solid (Non-Hazardous) Waste Requirements	Cal.Pub. Res. Code §40000-40201, 43000-44820; 27 CCR §§ 20005-20278	Relevant and appropriate	BAPR and CHP	These requirements govern off-site disposal of nonhazardous solid waste and closure and postclosure of solid waste management units.
Clean Closure Requirements	27 CCR § 20380(d)(2);27 CCR § 21090(f); CCR § 21410	Relevant and appropriate	BAPR and CHP	For clean closure, all waste, waste residues, contaminated containment systems components, contaminated subsoils, and all other contaminated materials are removed or decomtaminated at closure pursuant to the specific requirements for landfills, etc. Clean closure renders the landfill no longer a threat to water quality.

Table 2
Applicable or Relevant and Appropriate Requirements (ARARs)
Small Arms Firing Ranges
Presidio of San Francisco, California

ARAR or TBC	Citation or Authority	Type	Location	Description
Inert Waste Requirements	27 CCR § 20230	Relevant and appropriate	BAPR and CHP	Inert waste is a subset of solid waste that does not contain hazardous waste or soluble pollutants at concentrations in excess of applicable water quality objectives and does not contain significant quantities of decomposable waste. Inert wastes do not need to be discharged at classified units.
• Federal Clean Air Act, certain Bay Area Air Quality Management District (BAAQMD) Regulations	BAAQMD Regulations (see citations below)	Relevant and appropriate	BAPR and CHP	Implementation of federal Clean Air Act requirements has been delegated, in part, to the State of California. The BAAQMD is the local implementing agency. Where BAAQMD requirements have been incorporated into the State Implementation Plan and approved by EPA, they are federally-enforceable. Where BAAQMD requirements have not been incorporated into the SIP and approved by EPA, they are not federally enforceable.
Air Requirements	BAAQMD Regulation 6	Relevant and appropriate	BAPR and CHP	Regulation 6 limits emissions of particulates. Excavation activities at the SAFRs may result in particulate emissions. Regulation 6 is not SIP-approved and is not a federally enforceable requirement.
Air Requirements	BAAQMD Regulation 7; Regulation 8, Rule 40; and Regulation 9, Rule 2.	Relevant and appropriate	BAPR and CHP	These requirements regulate the emission of odorous substances, organic compounds, and hydrogen sulfide.
Air Requirements	BAAQMD Regulation 8, Rule 15	Relevant and appropriate	BAPR and CHP	BAAQMD Regulation 8, Rule 15 prohibits the use of certain types of liquid and emulsified asphalts (those that would emit large amounts of organic compounds). This rule was approved into the SIP on 22 March 1995, as amended by BAAQMD on 1 June 1994.

Table 2
Applicable or Relevant and Appropriate Requirements (ARARs)
Small Arms Firing Ranges
Presidio of San Francisco, California

ARAR or TBC	Citation or Authority	Type	Location	Description
• California prohibitions on polluting waters of the State	Cal. Fish & Game Code § 5650	Relevant and appropriate	BAPR and CHP	Cal. Fish & Game Code § 5650(a) prohibits depositing enumerated substances, including "any substance or material deleterious to fish, plant life, or bird life" into the waters of the state.
• California restrictions on means of taking birds or mammals	Cal. Fish & Game Code § 3005	Relevant and appropriate	BAPR and CHP	Section 3005 of the Cal. Fish & Game Code prohibits taking birds or mammals with "any net, pound, cage, trap, set line or wire, or poisonous substance, or to possess birds or mammals so taken," except as provided in the Fish & Game Code.
• City and County of San Francisco Sanitary Sewer Discharge Order	San Francisco Municipal Code: Public Works Code, Article 4.1, Industrial Waste, §§ 119, 123(a)–(c), 123(h), 123(i),124–127	To be Considered	BAPR and CHP	The City of San Francisco order is an industrial pretreatment permit which implements the State Water Code. Discharge to the sewer of groundwater from dewatering must meet these requirements.

Notes

a The recommended alternative for the SAFRs requiring remedial action (CHP and BAPR), Alternative 4, consists of: (a) excavating metal-contaminated soils; (b) confirmation soil sampling for soil COCs to confirm that applicable soil cleanup levels have been achieved; and (c) off-site disposal of contaminated soils at a permitted management facility.

Table 3
Cleanup Levels for Metals in Soil
Lobos Creek Target Butt
Small Arms Firing Ranges
Presidio of San Francisco, California

Chemical of Concern	Protection of Human Health Residential Cleanup Level (mg/kg)	Protection of Human Health Recreational Cleanup Level (mg/kg)	Protection of Ecological Receptors Special Status Species Cleanup Level (mg/kg)	Most Stringent Cleanup Level (mg/kg)
	Beach/Dune Sand	Beach/Dune Sand	Beach/Dune Sand	Beach/Dune Sand
Inorganic Chemicals				
Antimony	29	70	5.0	5.0
Copper	--	---	43 [a]	43
Lead	400	500	160	160
Zinc	22,000	52,000	66 [a]	66

Notes

[a] Cleanup level for this compound and this lithology is based on the background level in soil.

Source: Table 7-2 Summary of Selection of Preliminary Remediation Goals and Proposed Cleanup Levels for Non-Petroleum Compounds in Soil from Presidio-wide Cleanup Levels Document (EKI, 2002).

Shading indicates applicable cleanup level.

Table 4
Cleanup Levels for Metals in Soil
Lobos Creek Protected Range
Small Arms Firing Ranges
Presidio of San Francisco, California

Chemical of Concern	Protection of Human Health Recreational Cleanup Level (mg/kg)	Protection of Human Health Commercial/Industrial Cleanup Level (mg/kg)	Protection of Ecological Receptors Buffer Zone Cleanup Level (mg/kg)	Protection of Ecological Receptors Special Status Species Cleanup Level (mg/kg)	Most Stringent Cleanup Level (mg/kg)
	Beach/Dune Sand	Beach/Dune Sand	Beach/Dune Sand	Beach/Dune Sand	Beach/Dune Sand
Inorganic Chemicals					
Antimony	70	760	5.0	5.0	5.0
Copper	---	---	120	43 [a]	43
Lead	500	3,500	300	160	160
Zinc	52,000	570,000	66 [a]	66 [a]	66

Notes

[a] Cleanup level for this compound and this lithology is based on the background level in soil.

Source: Table 7-2 Summary of Selection of Preliminary Remediation Goals and Proposed Cleanup Levels for Non-Petroleum Compounds in Soil from Presidio-wide Cleanup Levels Document (EKI, 2002).

Shading indicates applicable cleanup level.

Table 5
Cleanup Levels for Metals in Soil
Machine Gun Butt
Small Arms Firing Ranges
Presidio of San Francisco, California

Chemical of Concern	Protection of Human Health Recreational Cleanup Level (mg/kg)			Protection of Ecological Receptors Buffer Zone Cleanup Level (mg/kg)			Most Stringent Cleanup Level (mg/kg)		
	Serpentinite	Beach/Dune Sand	Colma	Serpentinite	Beach/Dune Sand	Colma	Serpentinite	Beach/Dune Sand	Colma
Inorganic Chemicals									
Antimony	70	70	70	5.0	5.0	5.0	5.0	5.0	5.0
Copper	---	---	---	120	120	120	120	43	49
Lead	500	500	500	300	300	300	300	160	160
Zinc	52,000	52,000	52,000	160 [a]	66 [a]	60 [a]	160	66	60

Notes

[a] Cleanup level for this compound and this lithology is based on the background level in soil.

Source: Table 7-2 Summary of Selection of Preliminary Remediation Goals and Proposed Cleanup Levels for Non-Petroleum Compounds in Soil from Presidio-wide Cleanup Levels Document (EKI, 2002).

Although serpentinite and beach/dune sand were thought to be the predominant site lithologies in the RI/FS Work Plan, some RI soil samples collected were also representative of Colma lithology.

Shading indicates applicable cleanup level.

Table 6
Cleanup Levels for Metals in Soil
California Highway Patrol Pistol Range
Small Arms Firing Ranges
Presidio of San Francisco, California

Chemical of Concern	Protection of Human Health Recreational Cleanup Level (mg/kg)		Protection of Ecological Receptors Buffer Zone Cleanup Level (mg/kg)		Protection of Ecological Receptors Special Status Species Cleanup Level (mg/kg)		Most Stringent Cleanup Level (mg/kg)	
	Beach/Dune Sand	Colma	Beach/Dune Sand	Colma	Beach/Dune Sand	Colma	Beach/Dune Sand	Colma
Inorganic Chemicals								
Antimony	70	70	5.0	5.0	5.0	5.0	5.0	5.0
Copper	---	---	120	120	43 [a]	49 [a]	43	49
Lead	500	500	300	300	160	160	160	160
Zinc	52,000	52,000	66 [a]	60[a]	66 [a]	60 [a]	66	60

Notes

[a] Cleanup level for this compound and this lithology is based on the background level in soil.

Source: Table 7-2 Summary of Selection of Preliminary Remediation Goals and Proposed Cleanup Levels for Non-Petroleum Compounds in Soil from Presidio-wide Cleanup Levels Document (EKI, 2002).

Although serpentinite was thought to be the predominant site lithology in the RI/FS Work Plan, some RI soil samples collected were representive of beach/dune sand and Colma lithologies.

Shading indicates applicable cleanup level.

Table 7
Cleanup Levels for Metals in Soil
Barnard Avenue Protected Range
Small Arms Firing Ranges
Presidio of San Francisco, California

Chemical of Concern	Protection of Human Health Residential Cleanup Level (mg/kg)		Protection of Ecological Receptors Buffer Zone Cleanup Level (mg/kg)		Protection of Ecological Receptors Special Status Species Cleanup Level (mg/kg)		Most Stringent Cleanup Level (mg/kg)	
	Beach/Dune Sand	Colma	Beach/Dune Sand	Colma	Beach/Dune Sand	Colma	Beach/Dune Sand	Colma
Inorganic Chemicals								
Antimony	29	29	5.0	5.0	5.0	5.0	5.0	5.0
Copper	--	---	120	120	43a	49 [a]	43	49
Lead	400	400	300	300	160	160	160	160
Zinc	22,000	22,000	66 [a]	60 [a]	66 [a]	60 [a]	66	60

Notes

[a] Cleanup level for this compound and this lithology is based on the background level in soil.

Source: Table 7-2 Summary of Selection of Preliminary Remediation Goals and Proposed Cleanup Levels for Non-Petroleum Compounds in Soil from Presidio-wide Cleanup Levels Document (EKI, 2002).

Although Colma was thought to be the predominant site lithology in the RI/FS Work Plan, some RI samples collected were also representative of the beach/dune sand lithology.

Shading indicates applicable cleanup level.

Table 8
Screening Summary of General Response Actions, Technologies, and Process Options
Small Arms Firing Ranges
Presidio of San Francisco, California

General Response Action	Remedial Technology	Process Option	Description	Screening Status
No Action	None		No Action	Required for consideration by NCP.
Institutional Controls	Land Use Controls		Uses of Small Arms Firing Range sites are restricted or controlled by administrative procedures and/or requirements to follow the Presidio Trust's Land Use Controls Master Reference Report (Area B sites) or the NPS policies (Area A sites).	Potentially applicable.
	Monitoring		Routine inspections alone or in conjunction with ongoing soil sampling are performed to assess impacts on environmental conditions at the Small Arms Firing Range sites.	Applicable.
Containment	Permeable Cover	Asphalt or Soil	Applicable to wastes or soil with COCs that do not present a significant risk to groundwater. Clean soil or other suitable cover materials (e.g., asphalt) are used to minimize the potential for humans and ecological receptors to	Potentially applicable in conjunction with institutional controls.

Table 8
Screening Summary of General Response Actions, Technologies, and Process Options
Small Arms Firing Ranges
Presidio of San Francisco, California

General Response Action	Remedial Technology	Process Option	Description	Screening Status
			contact wastes and soil with COCs.	
	Low-Permeability Cover	Monolithic Soil Cover	Soil cover is constructed with specially designed thickness to minimize infiltration through run-off and enhanced evapotranspiration.	Not retained. Cover type best suited to areas with more arid climate.
		Geosynthetic Cover	Multi-layer cover consisting of a soil foundation layer, a geosynthetic liner, and a vegetative soil layer. Multi-layer cover system is placed over contaminated soil with soluble COCs that may impact groundwater.	Not retained. COCs are relatively immobile and do not present a substantial threat to groundwater.
In situ Soil Treatment	Physical/Chemical Technology	Immobilization	Cement or other chemical agents are injected and mixed with wastes and soil to immobilize COCs. Includes stabilization and solidification technologies.	Not retained. COCs in soil present at concentrations only slightly greater than applicable Cleanup Levels (CULs).
	Thermal Technology	Vitrification	Heat or electric current is applied to melt soil and to incorporate metals into vitrified mass.	Not retained. This technology is expensive and availability of equipment limits

Table 8
Screening Summary of General Response Actions, Technologies, and Process Options
Small Arms Firing Ranges
Presidio of San Francisco, California

General Response Action	Remedial Technology	Process Option	Description	Screening Status
				implementation.
	Biological Technology	Phytoremediation	Plants estabilished in soil uptake COCs and incorporate the chemicals in their plant structure. Plants are subsequently harvested for disposal at an off-site, permitted waste management facility.	Not retained. Army treatability study indicated the technology was not viable for soil at the Presidio.
Excavation	Offsite Disposal of Soil		Wastes and soil are transported to and disposed at an off-site, permitted waste management facility.	Applicable.
	Segregation of Ammunition Fragments and Soil	Recycle Ammunition Fragments and Dispose of Soil Offsite	Soil is separated from ammunition fragments and transported to offsite, permitted waste management facility. Ammunition fragments are recycled.	Not applicable. Ammunition fragments were only encountered in four sampling locations at CHP. The estimated quantity of fragments is negligible.

Table 9
Summary of Retained Technologies
Small Arms Firing Ranges
Presidio of San Francisco, California

General Response Action	Soil Remedial Technology Screened	Soil Process Option	Retained for Further Consideration
No Action			√
Institutional Controls	Land Use Controls		√
	Monitoring		√
Capping	Permeable Cover	Asphalt or Soil	√
	Low Permeability Cover	Geosynthetic Cover	
In-situ Soil Treatment	• Physical/Chemical Technology	Immobilization	
	• Thermal Technology	Vitrification	
	• Biological Treatment	Phytoremediation	
Excavation	Offsite Disposal of Soil and Wastes		√
	Segregation of Wastes and Soil		

Table 10
Screening And Summary of Remedial Alternatives Retained For Detailed Analysis
Small Arms Firing Ranges
Presidio of San Francisco, California

Site(s)	Soil Process Option	Effectiveness	Implementability	Cost	Status
California Highway Patrol Pistol Range (CHP) and Barnard Avenue Protected Range (BAPR)	No Action	Does not achieve remedial action objectives for sites with chemicals of concern (COCs) in soil above applicable cleanup levels.	Easily implemented	No cost	Retained, Required for consideration by NCP
CHP and BAPR	Institutional Controls (Land use controls)	May prevent direct contact with in-place soil if institutional controls are compatible with land use as defined in the Presidio Trust Management Plan (PTMP) and General Management Plan Agreement (GMPA).	Implementation depends upon characteristics and land use of the individual firing range.	Low cost	Retained
CHP and BAPR	Capping Soil with Permeable Cover	Likely to prevent direct contact with in-place soil if caps are maintained, land use controls are imposed, and both are compatible with land use as defined in PTMP and GMPA.	Implementation depends upon characteristics and land use of individual firing range.	Low to moderate cost	Retained
CHP and BAPR	Excavate and Dispose of Soil and Waste Off-site	Removal of contaminated soil will be effective in achieving applicable cleanup levels and allowing unrestricted land use.	Implementation depends on the specific land use at the CHP and BAPR and volume of contaminated soil.	Moderate cost	Retained

Table 11a
Detailed Analysis for No Action Alternative
Small Arms Firing Ranges
Presidio of San Francisco, California

EVALUATION CRITERIA	Conditions Under Which Alternative May be Applicable
THRESHOLD CRITERIA	
1) Overall protection of human health and the environment	Alternative may be protective of human health and the environment if chemicals of concern (COCs) are not present at the site above applicable human health and ecological cleanup levels.
2) Compliance with ARARs	If no remedial action is required at the site then ARARs will not apply.
BALANCING CRITERIA	
3) Long-term effectiveness and permanence	Alternative will offer long term effectiveness to human health and environment if COCs are not present above human health and ecological cleanup levels.
4) Reduction of Toxicity, Mobility, or Volume (TMV) through treatment	Alternative will not reduce toxicity, mobility or volume of waste. Waste will not need to be removed if COC concentrations do not exceed cleanup levels.
5) Short-term effectiveness	Alternative is not anticipated to result in short-term risks to park visitors or park maintenance workers.
6) Implementability	Alternative is implementable.
7) Cost	No cost associated with this alternative.
MODIFYING CRITERIA	
8) State acceptance	The State of California Regional Water Quality Control Board (RWQCB) and Environmental Protection Agency, Department of Toxics Substances Control (DTSC) will consider this alternative if COC concentrations at the site do not pose human health or environmental risks.
9) Community acceptance	Alternative may be accepted by the Restoration Advisory Board (RAB) and community if the soil contamination does not pose risks to human health and the environment.

Table 11a
Detailed Analysis for No Action Alternative
Small Arms Firing Ranges
Presidio of San Francisco, California

EVALUATION CRITERIA	Conditions Under Which Alternative May be Applicable
ADDITIONAL CRITERIA	
California Health and Safety Code Criteria	If COC concentrations do not exceed applicable cleanup levels, alternative may comply with health and safety code criteria.
SUMMARY OF EVALUATION CRITERIA	Alternative may be recommended for Small Arms Firing Range sites that do not warrant remedial action because the contamination will not pose human health or environmental risks. The no action alternative is used as a comparison to other remedial alternatives.

Table 11b
Detailed Analysis for Land Use
Controls Alternative
Small Arms Firing Ranges
Presidio of San Francisco, California

EVALUATION CRITERIA	Conditions Under Which Alternative May be Applicable
THRESHOLD CRITERIA	
1) Overall protection of human health and the environment	Alternative may be protective of human health and the environment, only if institutional controls (land use controls) that protect human health and the environment can be maintained on a long-term basis.
2) Compliance with ARARs	Some institutional controls may not comply with ARARs.
BALANCING CRITERIA	
3) Long-term effectiveness and permanence	Alternative may offer long-term effectiveness to human health and environment if institutional controls prevent exposure to COCs. However, it also needs long-term maintenance and monitoring. In addition, institutional controls must be compatible with defined land use at the Firing Ranges as documented in the Presidio Trust Management Plan (PTMP) and General Management Plan Agreement (GMPA).
4) Reduction of Toxicity, Mobility, or Volume (TMV) through treatment	Alternative will not reduce toxicity, mobility or volume of waste.
5) Short-term effectiveness	Alternative is not anticipated to result in short-term risks to park visitors or park maintenance workers.
6) Implementability	Alternative is implementable.
7) Cost	$201,000
MODIFYING CRITERIA	
8) State acceptance	The State of California Regional Water Quality Control Board (RWQCB) and Environmental Protection Agency, Department of Toxics Substances Control (DTSC) will consider this alternative if land use controls will prevent exposure to COCs and comply with ARARs.

Table 11b
Detailed Analysis for Land Use
Controls Alternative
Small Arms Firing Ranges
Presidio of San Francisco, California

EVALUATION CRITERIA	Conditions Under Which Alternative May be Applicable
9) Community acceptance	Alternative may be accepted by the Restoration Advisory Board (RAB) and community if the institutional controls protect human health and the environment, comply with ARARs and allows future land use as documented in the PTMP and GMPA.
ADDITIONAL CRITERIA	
California Health and Safety Code Criteria	Alternative may address some of the human health and safety as well as ecological risks.
SUMMARY OF EVALUATION CRITERIA	Alternative will not be recommended for sites where COCs are exceeding cleanup levels. Land use controls without engineering controls will not create a barrier between contaminated soil, human and ecological receptors.

Table 11c
Detailed Analysis for Capping with Permeable Cover Alternative
Small Arms Firing Ranges
Presidio of San Francisco, California

EVALUATION CRITERIA	Conditions Under Which Alternative May be Applicable
THRESHOLD CRITERIA	
1) Overall protection of human health and the environment	Alternative may be protective of human health and the environment if exposure to chemicals of concern (COCs) can be prevented.
2) Compliance with ARARs	Alternative may not comply with ARARs related to protection of cultural resources within Area A.
BALANCING CRITERIA	
3) Long-term effectiveness and permanence	Alternative will offer long-term effectiveness to human health and environment if soil caps are maintained and institutional controls are imposed to prevent disturbances to the cap.
4) Reduction of Toxicity, Mobility, or Volume (TMV) through treatment	Alternative will not reduce toxicity, mobility, or volume of waste through treatment.
5) Short-term effectiveness .	Alternative is not anticipated to result in short-term risks to park visitors or park maintenance workers.
6) Implementability	Alternative may not be implementable. Cap design may be difficult to coordinate with current land uses (i.e., historical berm structure at CHP and apartment complex at BAPR).
7) Cost	CHP = $364,000 BAPR = $319,000

Table 11c
Detailed Analysis for Capping with Permeable Cover Alternative
Small Arms Firing Ranges
Presidio of San Francisco, California

EVALUATION CRITERIA	Conditions Under Which Alternative May be Applicable
MODIFYING CRITERIA	
8) State acceptance	The State of California Regional Water Quality Control Board (RWQCB) and Environmental Protection Agency, Department of Toxics Substances Control (DTSC) will consider this alternative if it is protective of human health and the environment and complies with ARARs or a waiver is obtained for those ARARs that are not attainable with this alternative.
9) Community acceptance	Alternative may be accepted by the Restoration Advisory Board (RAB) and community if the soil contamination does not pose risks to human health and the environment, complies with ARARs, and allows future land use as documented in the General Management Plan Amendment (GMPA).
ADDITIONAL CRITERIA	
California Health and Safety Code Criteria	Alternative may address some of the human health and safety as well as ecological risks.
SUMMARY OF EVALUATION CRITERIA	
	Alternative may be recommended if the cap protects human health and the environment from contaminated soil; if a waiver can be obtained for unattainable ARARs; and if it is accepted by RWQCB, DTSC, RAB and members of the community.

Table 11d
Detailed Analysis for Excavation and Offsite Disposal of Soil Alternative
Small Arms Firing Ranges
Presidio of San Francisco, California

EVALUATION CRITERIA	Conditions Under Which Alternative May be Applicable
THRESHOLD CRITERIA	
1) Overall protection of human health and the environment	Alternative will be protective of human health and the environment if soil contamination is removed thereby eliminating potential human and ecological exposures.
2) Compliance with ARARs	Alternative is anticipated to comply with ARARs if soil has been identified as a source of chemicals of concern (COCs).
BALANCING CRITERIA	
3) Long-term effectiveness and permanence	Alternative will offer long term effectiveness to human health and environment if contaminated soil is removed from the sites.
4) Reduction of Toxicity, Mobility, or Volume (TMV) through treatment	Alternative will not likely reduce toxicity or mobility of COCs through treatment and will not decrease the volume of impacted soil.
5) Short-term effectiveness .	Alternative could be protective of short-term human health exposures for visitors. Normal construction practices and OSHA standards would be employed to to protect remedial construction workers.
6) Implementability	Alternative can be implemented at both sites.
7) Cost	CHP = $240,000 BAPR = $244,000
MODIFYING CRITERIA	
8) State acceptance	The State of California Regional Water Quality Control Board (RWQCB) and Environmental Protection Agency, Department of Toxics Substances Control (DTSC) will consider this alternative if it is protective of human health and the environment and complies with ARARs.
9) Community acceptance	Alternative may be accepted by the Restoration Advisory Board (RAB) and the soil contamination is removed protecting human health and the environment, complies with ARARs and allows future land use as documented in the Presidio Trust Management Plan and General Management Plan Amendment (GMPA).

Table 11d
Detailed Analysis for Excavation and Offsite Disposal of Soil Alternative
Small Arms Firing Ranges
Presidio of San Francisco, California

EVALUATION CRITERIA	Conditions Under Which Alternative May be Applicable
ADDITIONAL CRITERIA	
California Health and Safety Code Criteria	Alternative will likely address human health and safety as well as ecological risks and potential contaminant migration from the site.
SUMMARY OF EVALUATION CRITERIA	
	Alternative may be recommended for sites where COCs in soil are greater than applicable cleanup levels and use of capping system is not protective of human health and the environment.

Table 12a
Comparative Analysis of Remedial Alternatives
California Highway Patrol Pistol Range
Small Arms Firing Ranges
Presidio of San Francisco, California

Alternative 1	Alternative 2	Alternative 3	Alternative 4
No Action for Soil	**Institutional Controls (e.g. Land Use Controls)**	**Capping Soil with Permeable Cover**	**Soil Excavation, Off-site Disposal**
Objective The objective of this alternative is to provide no additional control or protection to human health or the environment for contamination that exists in the soil at the California Highway Patrol (CHP) Pistol Range.	The objective of this alternative is to prevent exposure to COCs in soil by designing non-engineering measures such as land use restrictive covenants, easements and zoning ordinances.	The objective of this alternative would be to maintain existing asphalt over the impacted areas at CHP and place permeable caps over uncovered soil to isolate the contamination from human and ecological exposure.	The objective of this alternative would be to remove fill and shallow soil contamination and segregate and dispose of waste materials as appropriate. Some soil treatment may be required prior to disposal.
THRESHOLD CRITERIA			
1) Overall protection of human health and the environment Alternative is not anticipated to provide an acceptable level of protection to human health and the environment.	Alternative is not anticipated to provide an acceptable level of protection to human health and the environment.	Alternative is protective of human health and the environment. Exposure to contamination is prevented.	Alternative is protective of human health and the environment. Fill and shallow soil contamination is removed, thereby eliminating potential human and ecological exposures.

Table 12a
Comparative Analysis of Remedial Alternatives
California Highway Patrol Pistol Range
Small Arms Firing Ranges
Presidio of San Francisco, California

Alternative 1	Alternative 2	Alternative 3	Alternative 4
2) Compliance with ARARs Alternative is not anticipated to comply with ARARs.	Alternative is not anticipated to comply with ARARs.	Alternative may not comply with certain ARARs.	Alternative is anticipated to comply with ARARs.
BALANCING CRITERIA			
3) Long-term effectiveness and permanence Alternative will not provide long-term protection against human or environmental exposures to contaminants of concern (COCs).	Alternative will not provide long-term protection against human or environmental exposures to contaminants of concern (COCs).	Alternative is expected to provide long-term effectiveness to human health and the environment if caps are maintained and land use controls imposed.	Alternative has long-term effectiveness and permanence. Contaminated soil is removed, thereby preventing worker and visitor exposures and impacts to environment.
4) Reduction of Toxicity, Mobility, or Volume (TMV) through treatment Alternative will not reduce toxicity, mobility or volume of waste.	Alternative will not reduce toxicity, mobility, or volume of waste.	Alternative will not reduce toxicity, mobility, or volume of waste.	Alternative will not reduce toxicity, mobility, or volume of waste.

Table 12a
Comparative Analysis of Remedial Alternatives
California Highway Patrol Pistol Range
Small Arms Firing Ranges
Presidio of San Francisco, California

Alternative 1	Alternative 2	Alternative 3	Alternative 4
5) Short-term effectiveness Alternative is not anticipated to result in short-term risks to park visitors or park maintenance workers.	Alternative is not anticipated to result in short-term risks to park visitors or park maintenance workers.	Alternative poses less short-term human health exposures for workers and visitors than excavation as soil will be largely undisturbed.	Alternative will be protective of short-term human health exposures for visitors. Normal construction practices and OSHA standards will be employed to protect remedial construction workers.
6) Implementability The no action alternative is implementable.	Alternative is implementable but it requires long term maintenance and monitoring.	Alternative may not be implementable. Part of the CHP Pistol Range is already capped with asphalt. This pre-existing cap could be maintained. Capping the impacted soil on top of the historic battery will be difficult to implement without damaging the historic structure.	Alternative is implementable. Some construction and design efforts will be needed to remove the contaminated soil from the historical battery at CHP.
7) Cost $0	$201,000 (both CHP and BAPR)	$364,000	$240,000

Table 12a
Comparative Analysis of Remedial Alternatives
California Highway Patrol Pistol Range
Small Arms Firing Ranges
Presidio of San Francisco, California

Alternative 1	Alternative 2	Alternative 3	Alternative 4
MODIFYING CRITERIA			
8) State acceptance The State of California Regional Water Quality Control Board (RWQCB) and Environmental Protection Agency, Department of Toxics Substances Control (DTSC) is unlikely to accept the alternative.	It is unlikely that RWQCB and DTSC will accept this alternative.	It is expected that RWQCB and DTSC will consider this alternative to be acceptable provided a waiver can be obtained for unattainable ARARs.	It is expected that RWQCB and DTSC will consider this alternative to be acceptable.
9) Community acceptance The No Action Alternative is anticipated to be disfavored by members of the Restoration Advisory Board (RAB) and the community at large.	RAB and members of the community may prefer excavation and/or treatment of contaminated soil to limit long-term required maintenance.	RAB may prefer excavation and/or treatment of contaminated soil.	Alternative is likely to be acceptable to the RAB and community since contaminated soil will be removed.

Table 12a
Comparative Analysis of Remedial Alternatives
California Highway Patrol Pistol Range
Small Arms Firing Ranges
Presidio of San Francisco, California

Alternative 1	Alternative 2	Alternative 3	Alternative 4
ADDITIONAL CRITERIA			
California Health and Safety Code Criteria No action Alternative does not address the health and safety risks posed by the site, the effect of contamination on future uses at the site and the potential for migration of contamination from the site from wind and rain erosion.	Alternative addresses some of the human health and environmental risks posed by the site.	Alternative addresses some of the human health and safety as well as ecological risks posed by contamination at the site and potential contaminant migration from the site.	Alternative addresses the human health and safety as well as ecological risks posed by contamination at the site or migration of contamination from the site. This remedy provides a cost effective remedial alternative for this site. This alternative will include some land disposal of excavated soil. The potential future threat to surface water will be eliminated by moving contaminated soil from an uncontrolled site to a licensed landfill.

Table 12a
Comparative Analysis of Remedial Alternatives
California Highway Patrol Pistol Range
Small Arms Firing Ranges
Presidio of San Francisco, California

Alternative 1	Alternative 2	Alternative 3	Alternative 4
SUMMARY OF EVALUATION CRITERIA			
Alternative is Not Recommended. COC concentrations in soil are greater than applicable cleanup levels and may pose unacceptable risks to human health and environment.	**Alternative is Not Recommended** Although the alternative is the least in cost, it may not be protective of human health and environment, depending on future land use as documented in the PTMP and GMPA. Since contaminated soil is not removed from the site it is unlikely that RWQCB and DTSC will accept this alternative.	**Alternative is Not Recommended.** Alternative is likely to be protective of human health and the environment and acceptable to RWQCB and DTSC. This alternative will require land use controls, long-term monitoring and maintenance of the cover to protect potential receptors from exposure to COCs. Implementation of caps will be difficult due to current land use and the historic battery.	**Alternative is Recommended as the Preferred Remedy.** This alternative would provide a permanent solution by removing COCs from soil and is less expensive than capping with institutional controls.

Table 12b
Comparative Analysis of Remedial Alternatives
Barnard Avenue Protected Range
Small Arms Firing Ranges
Presidio of San Francisco, California

Alternative 1	Alternative 2	Alternative 3	Alternative 4
No Action for Soil	**Institutional Controls (e.g. Land Use Controls)**	**Capping Soil with Permeable Cover**	**Soil Excavation, Off-Site Disposal**
Objective The objective of this alternative is to provide no additional control or protection to human health or the environment for contamination that exists in the soil at the Barnard Avenue Protected Range (BAPR).	The objective of this alternative is to prevent exposure to COCs in soil by designing non-engineering measures such as land use restrictive covenants, easements and zoning ordinances.	The objective of this alternative would be to maintain existing asphalt over the impacted areas at BAPR and place permeable caps over uncovered soil to isolate the contamination from human exposure. Institutional controls will be required.	The objective of this alternative would be to remove fill and shallow soil contamination and dispose of waste materials as appropriate. Some soil treatment may be required prior to disposal. Land use controls will be required for areas that are currently inaccessible until building demolition and removal and disposal of contaminated soil are implemented.
THRESHOLD CRITERIA			
1) Overall protection of human health and the environment Alternative is not anticipated to provide an acceptable level of protection to human health and the environment.	Alternative is not anticipated to provide an acceptable level of protection to human health and the environment.	Alternative is protective of human health and the environment. Exposure to contamination is prevented.	Alternative is protective of human health and the environment. Fill and shallow soil contamination is removed, thereby eliminating potential human and ecological exposures.

Table 12b
Comparative Analysis of Remedial Alternatives
Barnard Avenue Protected Range
Small Arms Firing Ranges
Presidio of San Francisco, California

Alternative 1	Alternative 2	Alternative 3	Alternative 4
2) Compliance with ARARs Alternative is not anticipated to comply with ARARs.	Alternative is not anticipated to comply with ARARs.	Alternative may not comply with ARARs.	Alternative is anticipated to comply with ARARs.
BALANCING CRITERIA			
3) Long-term effectiveness and permanence Alternative will not provide long-term protection against human or environmental exposures to contaminants of concern (COCs).	Alternative will not provide long-term protection against human or environmental exposures to contaminants of concern (COCs).	Alternative is expected to provide long-term effectiveness to human health and the environment if caps are maintained and land use controls imposed.	Alternative has long-term effectiveness and permanence. Contaminated soil is removed, thereby preventing worker and visitor exposures and impacts to environment.
4) Reduction of Toxicity, Mobility, or Volume (TMV) through treatment Alternative will not reduce toxicity, mobility or volume of waste.	Alternative will not reduce toxicity, mobility or volume of waste.	Alternative will not reduce toxicity, mobility, or volume of waste.	Alternative will not reduce toxicity, mobility, or volume of waste.

Table 12b
Comparative Analysis of Remedial Alternatives
Barnard Avenue Protected Range
Small Arms Firing Ranges
Presidio of San Francisco, California

Alternative 1	Alternative 2	Alternative 3	Alternative 4
5) Short-term effectiveness			
Alternative is not anticipated to result in short-term risks to park visitors or park maintenance workers.	Alternative is not anticipated to result in short-term risks to park visitors or park maintenance workers.	Alternative posses less short-term human health exposures for workers and visitors than excavation as soil will be largely undisturbed.	Alternative will be protective of short-term human health exposures for visitors. Normal construction practices and OSHA standards will be employed to protect remedial construction workers.
6) Implementability			
The no action alternative is implementable.	Alternative is implementable but it requires long term maintenance and monitoring. Institutional controls at BAPR must accommodate for the removal of Buildings 808 and 809. The Presidio Trust has this tentatively scheduled in 15 years.	Alternative may be implementable. Part of the BAPR is already capped with asphalt, concrete and Buildings 808 and 809. This pre-existing cap could be maintained; however, Building 808 and 809 are scheduled to be removed in the future. Institutional controls must accommodate for this land use change.	Alternative is implementable. Remedial excavation plans would need to consider the removal of contaminated soil, if present, from beneath Building 808 and 809 and surrounding parking areas. This could not occur until the buildings are demolished.
7) Cost $0	$201,000 (both CHP and BAPR)	$319,000	$244,000

Table 12b
Comparative Analysis of Remedial Alternatives
Barnard Avenue Protected Range
Small Arms Firing Ranges
Presidio of San Francisco, California

Alternative 1	Alternative 2	Alternative 3	Alternative 4
MODIFYING CRITERIA			
8) State acceptance The State of California Regional Water Quality Control Board (RWQCB) and Environmental Protection Agency, Department of Toxics Substances Control (DTSC) is unlikely to accept the alternative.	It is unlikely that RWQCB and DTSC will accept this alternative.	It is expected that RWQCB and DTSC will consider this alternative to be acceptable.	It is expected that RWQCB and DTSC will consider this alternative to be acceptable.
9) Community acceptance The No Action Alternative is anticipated to be disfavored by members of the Restoration Advisory Board (RAB) and the community at large.	RAB and members of the community may prefer excavation and/or treatment of contaminated soil to limit long term required maintenance.	RAB may prefer excavation and/or treatment of contaminated soil.	Alternative is likely to be acceptable to the RAB and community since contaminated soil will be removed.

Table 12b
Comparative Analysis of Remedial Alternatives
Barnard Avenue Protected Range
Small Arms Firing Ranges
Presidio of San Francisco, California

Alternative 1	Alternative 2	Alternative 3	Alternative 4
ADDITIONAL CRITERIA			
California Health and Safety Code Criteria No action Alternative does not address the health and safety risks posed by the site, the effect of contamination on future uses at the site and the potential for migration of contamination from the site from wind and rain erosion.	Alternative addresses some of the human health and environmental risks posed by the site.	Alternative addresses some of the human health and safety as well as ecological risks posed by contamination at the site and potential contaminant migration from the site.	Alternative addresses the human health and safety as well as ecological risks posed by contamination at the site or migration of contamination from the site. This remedy provides a cost effective remedial alternative for this site. This alternative will include some land disposal of excavated soil. The potential future threat to environment from wind and rainwater erosion will be eliminated by moving contaminated soil from an uncontrolled site to a licensed landfill.

Table 12b
Comparative Analysis of Remedial Alternatives
Barnard Avenue Protected Range
Small Arms Firing Ranges
Presidio of San Francisco, California

Alternative 1	Alternative 2	Alternative 3	Alternative 4
SUMMARY OF EVALUATION CRITERIA			
Alternative is Not Recommended. COC concentrations in soil are greater than applicable cleanup levels and may pose unacceptable risks to human health and environment.	**Alternative is Not Recommended** Although the alternative is the least in cost, it may not be protective of human health and environment, depending on future land use as documented in the PTMP and GMPA. Since contaminated soil is not removed from the site it is unlikely that RWQCB and DTSC will accept this alternative.	**Alternative is Not Recommended.** Alternative is likely to be protective of human health and the environment and acceptable to RWQCB and DTSC. This alternative will require land use controls, long-term monitoring and maintenance of the cover to protect potential receptors from exposure to COCs. Land use controls must accommodate for the future removal of Buildings 808 and 809.	**Alternative is Recommended as the Preferred Remedy.** This alternative would provide a permanent solution by removing COCs from the site and is less expensive than capping with land use controls. Soil excavation will occur in two phases. The first phase will cover currently accessible areas. The second phase will occur following the period of land use controls and demolition of Buildings 808 and 809.

Table 13
Summary of Preferred Alternatives and Estimated Present Worth Costs
Small Arms Firing Ranges
Presidio of San Francisco, California

Site		Alternative	Capital Cost[a]	Annual O&M Cost[a]	Maintenance Period[b] (years)	Interest Rate[c] (APR[d])	Total Cost (NPV[e])
All Soil Remedial Units	1)	No Action	$ ---	$ ---	---	3.5%	**$ ---**
	2)	Land Use Controls	$ 15,100	$ 10,100	30	3.5%	**$ 201,000**
California Highway Patrol	3)	Capping	$ 154,000	$ 11,400	30	3.5%	**$ 364,000**
	4)	Soil Excavation with Off-site Disposal and Recycling	$ 240,000	$ ---	---	3.5%	**$ 240,000**
Barnard Avenue Protected Range	3)	Capping	$ 133,000	$ 10,100	30	3.5%	**$ 319,000**
	4)	Soil Excavation with Off-site Disposal and Recycling	$ 244,000	$ ---	---	3.5%	**$ 244,000**
Combined Estimated Cost of Preferred Alternatives (Alternative 4 for California Highway Patrol and for Barnard Avenue Protected Range)							**$ 484,000**

Notes
[a] Detailed cost estimates for capital and annual costs are presented in Appendix C, Tables C-1 through C-6.
[b] The 30-year monitoring period is per OSWER guidance (EPA, 2000b).
[c] The 3.5% interest rate is per OSWER guidance (EPA, 2000b) and Federal guidelines (EPA, 2000a).
[d] APR = Annual Percentage Rate
[e] NPV = Net Present Value

FIGURES

N

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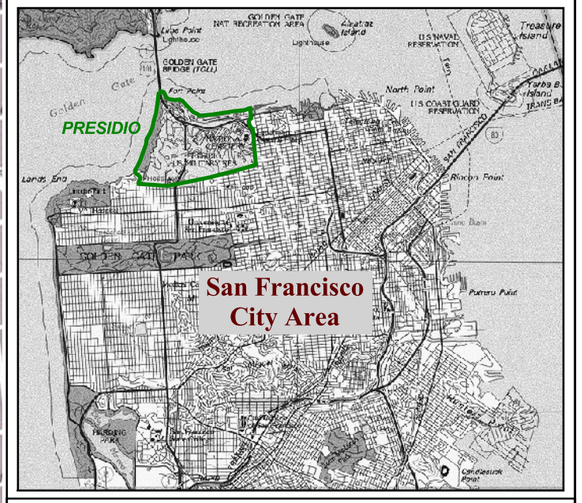
1000 0 1000 Feet

LEGEND

- Area Depicted on Site Figures
- Firing Range Boundary from Montgomery Watson 1997 SI
- Area A and B boundary

Notes:
Area A Stewardship by the National Park Service.
Area B Stewardship by the Presidio Trust.



SMALL ARMS FIRING RANGES SITE LOCATION MAP

Treadwell&Rollo

THE PRESIDIO TRUST

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November 2004

FIGURE 1

Treadwell & Rollo 2893_07\SAFR_FS.APR 11/2004

Soil Cleanup Levels (mg/kg)	
Copper	43
Zinc	66

LCBSB36	[0.3]	[1]	[1.5]-DU
Zinc	94	70	33

LCBSB24	[1]	[1.5]-DU	[2.5]
Copper	56	3.1	2.2

UNPAVED PATH
Lobos Creek
BOWLEY ST
LINCOLN BLVD
Aproximate Location of Former Building 1788
PARKING LOT
BOARDWALK
Lobos Creek
1705
1750
1786
LCBSB01 LCBSB02 LCBSB03 LCBSB04 LCBSB05 LCBSB06 LCBSB07 LCBSB08 LCBSB09 LCBSB10 LCBSB11 LCBSB12 LCBSB13 LCBSB14 LCBSB15 LCBSB16 LCBSB17 LCBSB18 LCBSB19 LCBSB20 LCBSB21 LCBSB22 LCBSB23 LCBSB24 LCBSB25 LCBSB26 LCBSB27 LCBSB28 LCBSB29 LCBSB30 LCBSB31 LCBSB32 LCBSB33 LCBSB34 LCBSB35 LCBSB36 LCBSB37 LCBSB38 LCBSB39 LCBSB40 LCBSB41 LCBSB42
40 50 60 70 80 90 100 110
N
80 0 80 Feet
DRAFT

LEGEND

- Soil Boring (COC Concentrations Below Cleanup Levels)
- One or more COCs in samples from this location exceeded a cleanup level, but further action is not warranted.
- Firing Range Boundary from Montgomery Watson 1997 SI
- Creek
- Presidio Base Map
- Presidio Boundary
- 90 Topographic Contours (Contour Interval : 10 ft)
- Trench
- Soil Berm
- Former Building
- 1750 Building and Number

[Depth in feet]

LCBSB36	[0.3]	[1]	[1]-DU
Zinc	94	70	33

Duplicate Sample

Values in pink are above cleanup levels.

Notes:
Results reported in milligrams/kilogram (mg/kg).

COC - Contaminant of Concern

Base map was provided by the Presidio Trust in June 2003.

Horizontal Datum: NAD 27, CA State Plane Coordinates, Zone 3, feet
Vertical Datum: North American Vertical Datum, NAVD88 (topography)

LOBOS CREEK TARGET BUTT CONTAMINANTS OF CONCERN

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November 2004

FIGURE 2

Treadwell & Rollo 2893_07\SAFR_FS.APR 11/2004

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Soil Cleanup Levels (mg/kg)	
Zinc	66

LCPSB37 [1] [1.5]-DU [2]
Zinc 85 18 12

LCPSB27 [1] [2]
Zinc 110 11

LCPSB31 LCPSB33 LCPSB34 LCPSB30 LCPSB35 LCPSB32 LCPSB29 LCPSB36 LCPSB28 LCPSB37 LCPSB27 LCPSB19 LCPSB18 LCPSB22 LCPSB20 LCPSB23 LCPSB21 LCPSB26 LCPSB24 LCPSB25 LCPSB07 LCPSB06 LCPSB05 LCPSB04 LCPSB02 LCPSB03 LCPSB01 LCPSB17 LCPSB12 LCPSB16 LCPSB11 LCPSB15 LCPSB13 LCPSB10 LCPSB14 LCPSB08 LCPSB09

1703 1704 1705 1706 1707 1708 1709 1750 1752

BOWLEY ST
LINCOLN BLVD
PARKING LOT
BOARDWALK
Overhang
Lobos Creek

N
150 0 150 Feet

LEGEND

- Soil Boring (COC Concentrations Below Cleanup Levels)
- One or more COCs in samples from this location exceeded a cleanup level, but further action is not warranted.
- Firing Range Boundary from Montgomery Watson 1997 SI
- Creek
- Presidio Base Map
- Presidio Boundary
- 90 — Topographic Contours (Contour Interval : 10 ft)
- Approximate boundary of sand placement and recontouring for Lobos Creek native plant restoration (NPS, 1998). This area contains special status plants.
- 1750 — Building and Number

[Depth in feet]

LCPSB27 [1]
Zinc 110

Values in pink are above cleanup levels.

Notes:
Results reported in milligrams/kilogram (mg/kg).

COC - Contaminant of Concern

Base map was provided by the Presidio Trust in June 2003.

Horizontal Datum: NAD 27, CA State Plane Coordinates, Zone 3, feet
Vertical Datum: North American Vertical Datum, NAVD88 (topography)

LOBOS CREEK PROTECTED RANGE CONTAMINANTS OF CONCERN

Treadwell&Rollo

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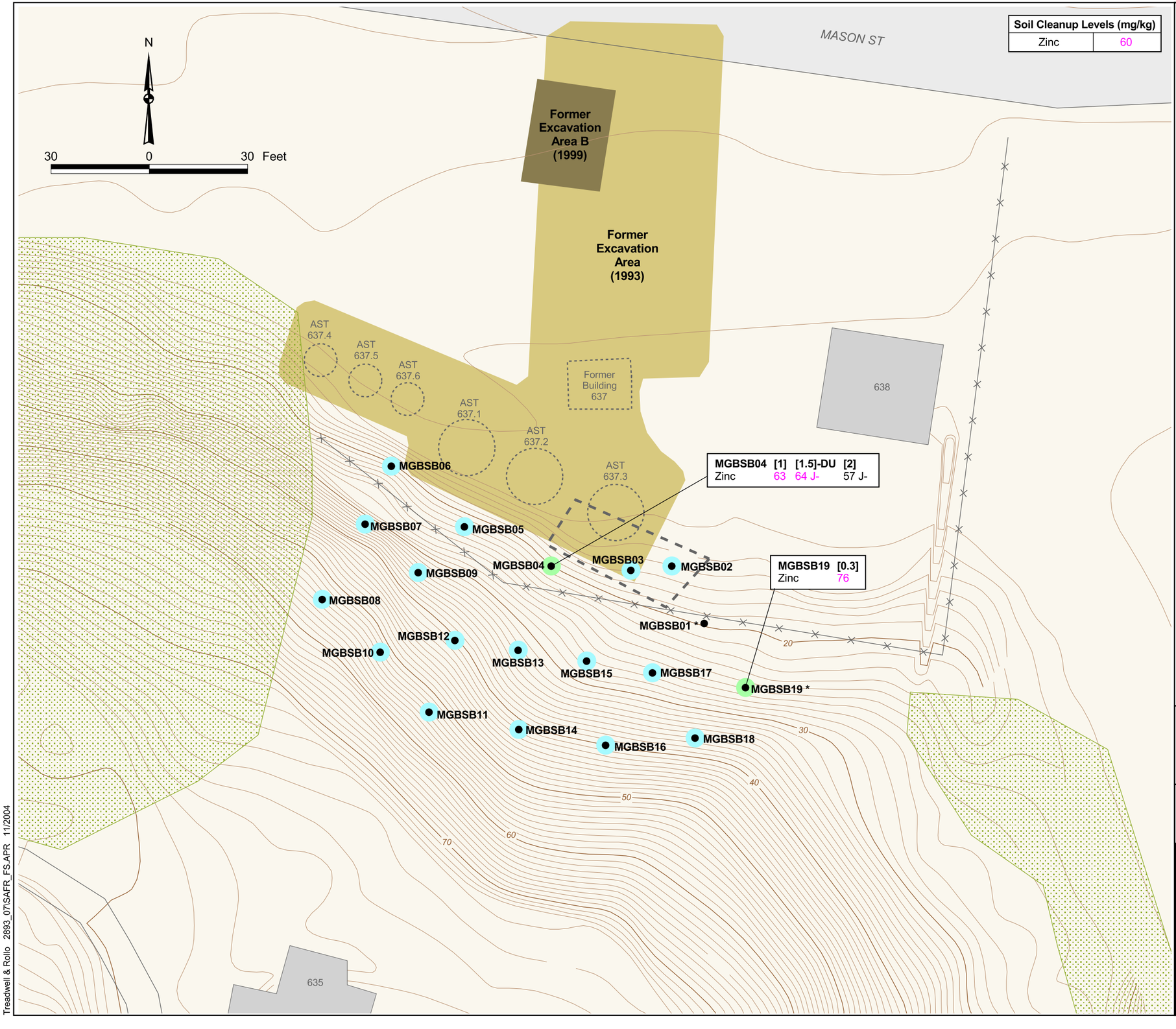
November 2004

FIGURE 3

Treadwell & Rollo 2893_07\SAFR_FS.APR 11/2004



DRAFT

LEGEND

- Soil Boring (COC Concentrations Below Cleanup Levels)
- One or more COCs in samples from this location exceeded a cleanup level, but further action is not warranted.
- Firing Range Boundary from Montgomery Watson 1997 SI
- Fence Boundary
- Presidio Base Map
- 30 — Topographic Contours (Contour Interval : 10 ft)
- Former Above Ground Storage Tank
- Sensitive Habitat (NPS, 2001a)
- 638 — Building and Number

[Depth in feet]

MGBSB04 [1] [1.5]-DU — Duplicate Sample
Zinc 63 34 J- — Data Qualifiers

Values in pink are above cleanup levels.

Notes:
* Bedrock encountered at 6 to 9 inches below surface, no soil sample collected or only 0.3-foot sample collected.

Results reported in milligrams/kilogram (mg/kg).

COC - Contaminant of Concern

Base map was provided by the Presidio Trust in June 2003.

Horizontal Datum: NAD 27, CA State Plane Coordinates, Zone 3, feet
Vertical Datum: North American Vertical Datum, NAVD88 (topography)

MACHINE GUN BUTT CONTAMINANTS OF CONCERN

Treadwell&Rollo

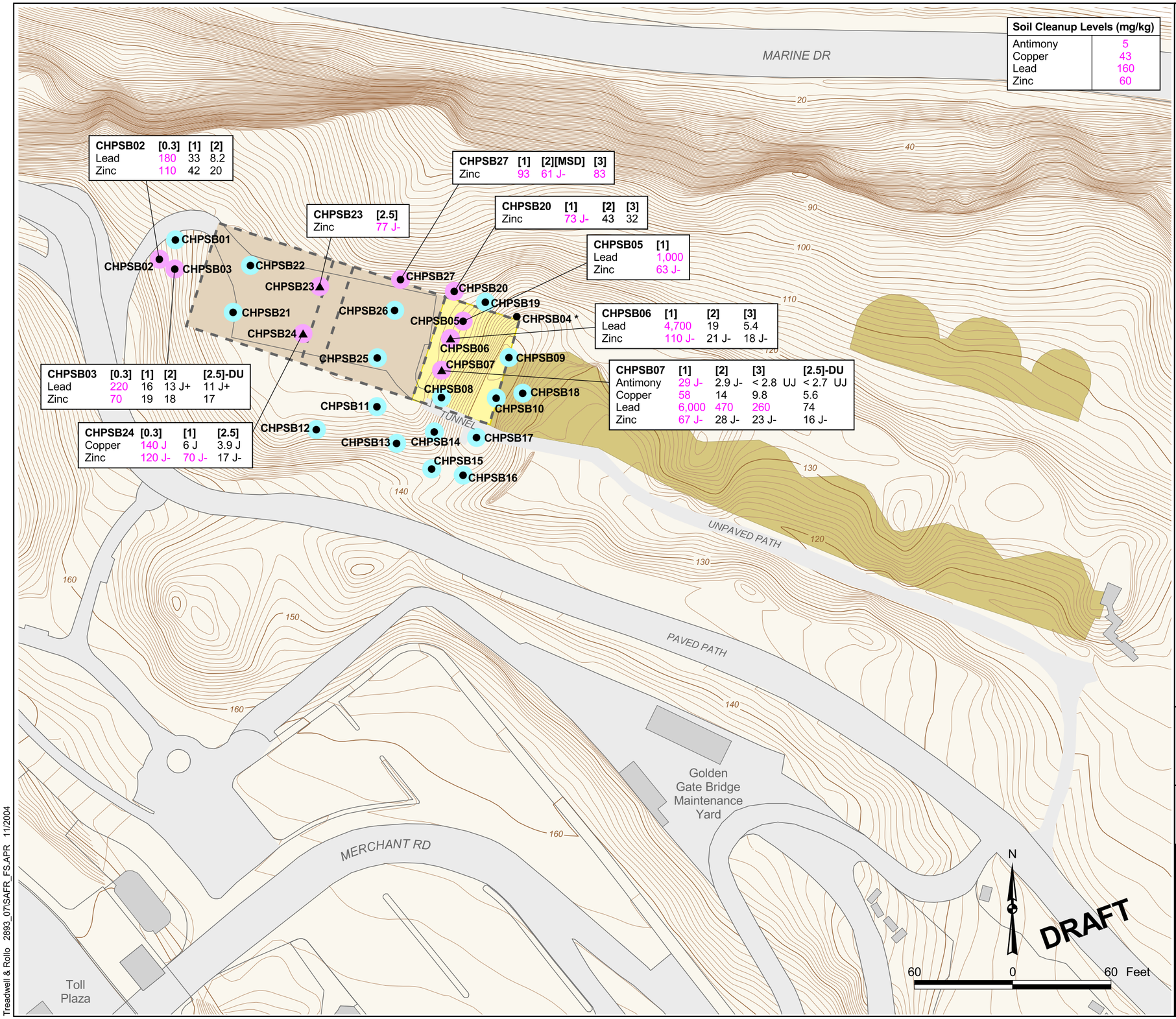
THE PRESIDIO TRUST

Presidio Trust
34 Graham Street
P.O. Box 29052
San Francisco, CA
94129-0052
415/561-5300
fax 415/561-5315

November 2004

FIGURE 4

Treadwell & Rollo 2893_07\SAFR_FS.APR 11/2004



Soil Cleanup Levels (mg/kg)	
Antimony	5
Copper	43
Lead	160
Zinc	60

LEGEND

- Soil Boring (COC Concentrations Below Cleanup Levels)
- One or more COCs in samples from this location exceeded a cleanup level and further action is warranted.
- Bullets and/or Shell Casings Present
- Firing Range Boundary from Montgomery Watson 1997 SI
- Presidio Base Map
- 90 Topographic Contours (Contour Interval : 10 ft)
- Battery Portions Used as Backstop
- Gun Battery East
- Pavement
- Building

[Depth in feet] Duplicate Sample

CHPSB07	[1]	[2]	[3]	[3]-DU
Antimony	29 J-	2.9 J-	< 2.8 UJ	< 2.7 UJ
Copper	58	14	9.8	5.6
Lead	6,000	470	260	74
Zinc	67 J-	28 J-	23 J-	16 J-

Values in pink are above cleanup levels.

Data Qualifiers

Notes:
* Subsurface obstruction encountered at 10 inches below surface, no soil sample collected.

Results reported in milligrams/kilogram (mg/kg).

COC - Contaminant of Concern

Base map was provided by the Presidio Trust in June 2003.

Horizontal Datum: NAD 27, CA State Plane Coordinates, Zone 3, feet
Vertical Datum: North American Vertical Datum, NAVD88 (topography)

CALIFORNIA HIGHWAY PATROL PISTOL RANGE CONTAMINANTS OF CONCERN

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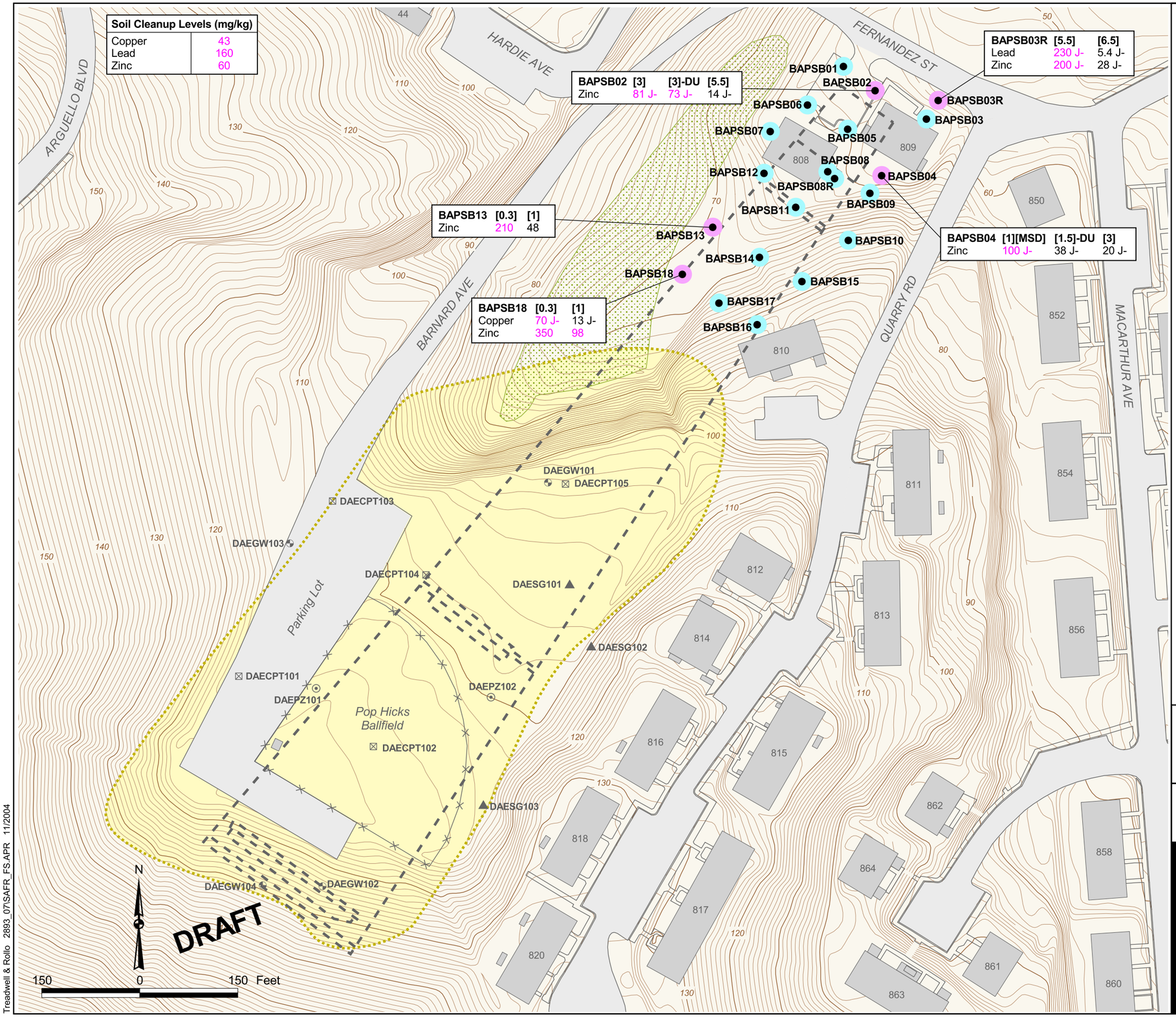
FIGURE 5

Treadwell & Rollo 2893_07\SAFR_FS.APR 11/2004



LEGEND

- Soil Boring (COC Concentrations Below Cleanup Levels)
- One or more COCs in samples from this location exceeded a cleanup level and further action is warranted.
- ⊠ DAECPT102 — Trust CPT Location
- ⊙ DAEPZ102 — Trust Piezometer
- DAEGW104 — Trust Groundwater Monitoring Well
- ▲ DAESG102 — Trust Soil Gas Probe
- Firing Range Boundary from 1909 Map from NPS GGNRA Archives
- Presidio Base Map
- 90 — Topographic Contours (Contour Interval : 10 ft)
- Landfill E Boundary from Draft Landfill E Field Sampling Report (EKI & Golder, 2003).
- Sensitive Habitat (NPS, 2001a)
- 811 — Building and Number

[Depth in feet] — Duplicate Sample

BAPSB02 [3] [3]-DU [5.5]
Zinc 81 J- 73 J- 14 J-

Values in pink are above cleanup levels. — Data Qualifiers

Notes:
Results reported in milligrams/kilogram (mg/kg).

COC - Contaminant of Concern

Firing range effects beneath the landfill were investigated as part of the 2002 Landfill E investigation, and the results will be reported in the Draft Landfill E Field Sampling Report (EKI & Golder, 2003).

Base map was provided by the Presidio Trust in June 2003.

Horizontal Datum: NAD 27, CA State Plane Coordinates, Zone 3, feet
Vertical Datum: North American Vertical Datum, NAVD88 (topography)

BARNARD AVENUE PROTECTED RANGE CONTAMINANTS OF CONCERN

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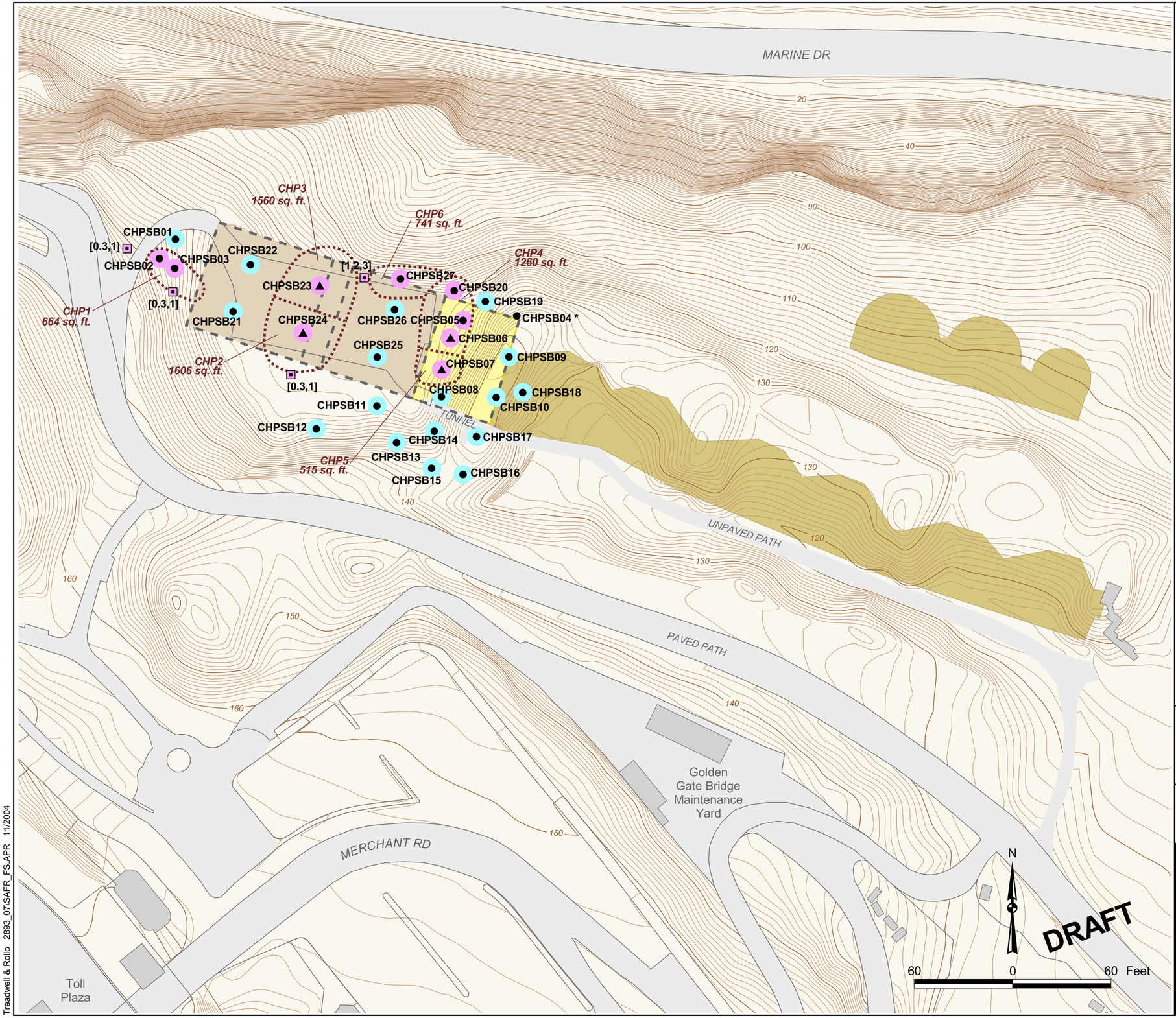
FIGURE 6

Treadwell & Rollo 2893_07\SAFR_FS.APR 11/2004



LEGEND

- Soil Boring (COC Concentrations Below Cleanup Levels)
- One or more COCs in samples from this location exceeded a cleanup level and further action is warranted.
- ▲ Bullets and/or Shell Casings Present
- [0.3,1] Proposed Pre-Capping Sampling Location [Depth in feet]
- CHP1 664 sq. ft. Excavation Area and Associated Square Footage (Appendix C, Table C-8)
- Estimated Extent of Cap or Excavation
- Firing Range Boundary from Montgomery Watson 1997 SI
- Presidio Base Map
- 90 Topographic Contours (Contour Interval : 10 ft)
- Battery Portions Used as Backstop
- Gun Battery East
- Pavement
- Building

Notes:
* Subsurface obstruction encountered at 10 inches below surface, no soil sample collected.

Results reported in milligrams/kilogram (mg/kg).

COC - Contaminant of Concern

Base map was provided by the Presidio Trust in June 2003.

Horizontal Datum: NAD 27, CA State Plane Coordinates, Zone 3, feet
Vertical Datum: North American Vertical Datum, NAVD88 (topography)

CALIFORNIA HIGHWAY PATROL PISTOL RANGE SOIL IMPACTS

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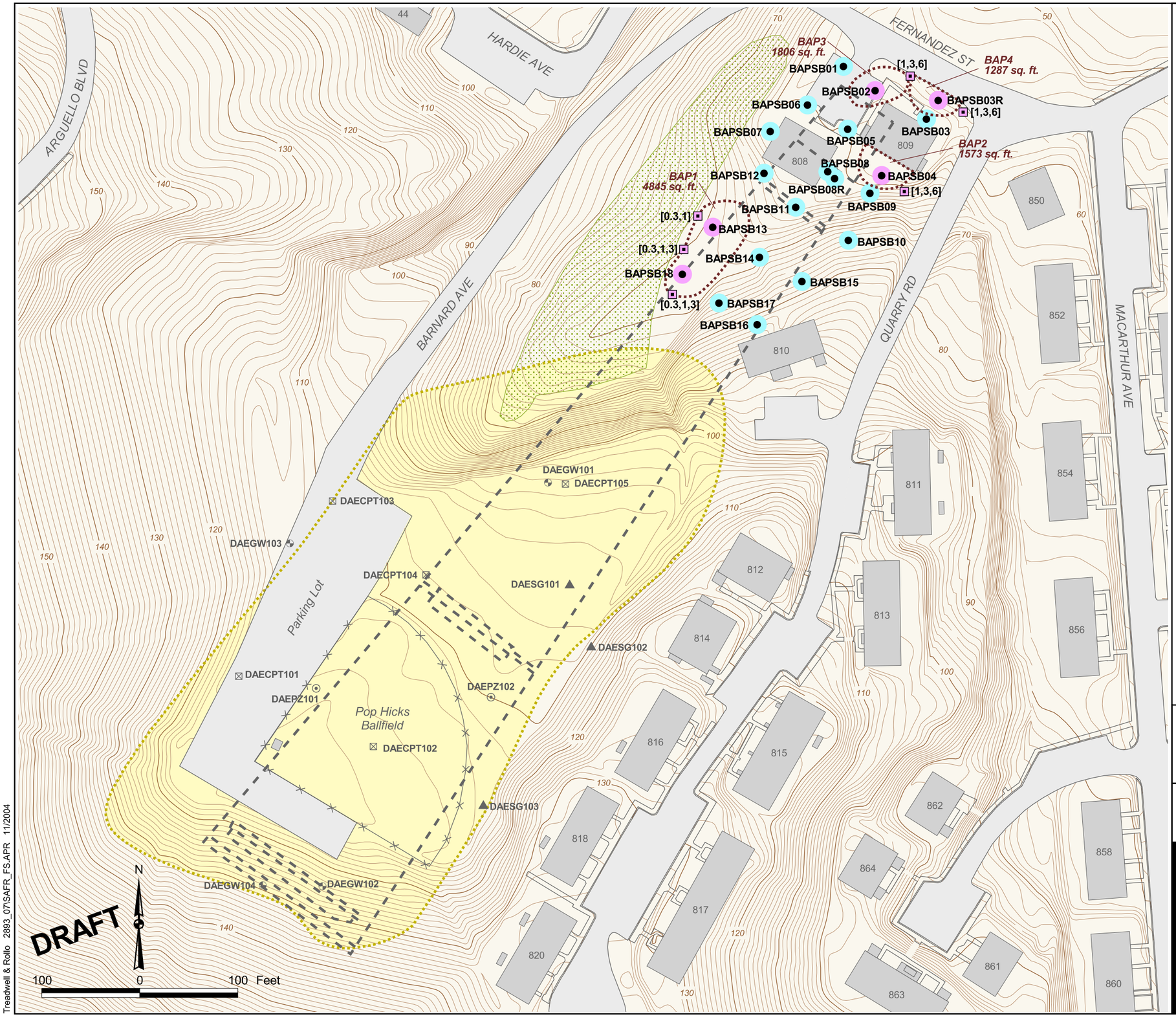
FIGURE 7

Treadwell & Rollo 2893_07\SAFR_FS.APR 11/2004



LEGEND

- Soil Boring (COC Concentrations Below Cleanup Levels)
- One or more COCs in samples from this location exceeded a cleanup level and further action is warranted.
- [1,3,6] Proposed Pre-Capping Sampling Location [Depth in feet]
- DAECPT102 Trust CPT Location
- DAEPZ102 Trust Piezometer
- DAEGW104 Trust Groundwater Monitoring Well
- DAESG102 Trust Soil Gas Probe
- BAP1 4845 sq. ft. Excavation Area and Associated Square Footage (Appendix C, Table C-8)
- Estimated Extent of Capping or Excavation
- Firing Range Boundary from 1909 Map from NPS GGNRA Archives
- Presidio Base Map
- 90 Topographic Contours (Contour Interval : 10 ft)
- Landfill E Boundary from Draft Landfill E Field Sampling Report (EKI & Golder, 2003).
- Sensitive Habitat (NPS, 2001a)
- 811 Building and Number

Notes:
Results reported in milligrams/kilogram (mg/kg).

COC - Contaminant of Concern

Firing range effects beneath the landfill were investigated as part of the 2002 Landfill E investigation, and the results will be reported in the Draft Landfill E Field Sampling Report (EKI & Golder, 2003).

Base map was provided by the Presidio Trust in June 2003.

Horizontal Datum: NAD 27, CA State Plane Coordinates, Zone 3, feet
Vertical Datum: North American Vertical Datum, NAVD88 (topography)

BARNARD AVENUE PROTECTED RANGE SOIL IMPACTS

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FIGURE 8

Treadwell & Rollo 2893_07\SAFR_FS.APR 11/2004

APPENDIX A

Responsiveness Summary
(To be Included in Final Report)

APPENDIX B

RI Metals Results

Table B-1
Summary of Metals Results in Soil
Lobos Creek Target Butt
Small Arms Firing Ranges
Presidio of San Francisco, California

			Aluminum (mg/kg)	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Magnesium (mg/kg)	Manganese (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Thallium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)
		Analytical Method	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020
Cleanup Level			**NE**	**5**	**5.9**	**320**	**10**	**1.7**	**120**	**20**	**43**	**NE**	**160**	**NE**	**NE**	**70**	**0.75**	**2**	**1**	**92**	**66**
Sample Name	**Sample Date**	**Sample Depth (feet)**																			
LCBSB01[0.3]	07/31/03	0.3	3,300	< 2.7 UJ	1.7	16 J-	0.16	0.66	23 J-	3.7 J-	3.2 J-	6,600	2.8 J-	1,600	97	19 J-	< 0.23 UJ	< 0.23	< 0.23 UJ	16 J-	14 J-
LCBSB01[1]	07/31/03	1	3,600	< 2.8 UJ	1.4	25 J-	0.17	0.95	23 J-	3.9 J-	4.4 J-	1,400	8.4 J-	1,600	120	18 J-	< 0.23 UJ	< 0.23	< 0.23 UJ	18 J-	17 J-
LCBSB02[1]	07/24/03	1	NA	< 3	NA	20	NA	NA	NA	NA	3.6	NA	3.2	NA	NA	NA	NA	NA	NA	NA	19
DUP072403D	07/24/03	1.5	NA	< 2.7 UJ	NA	23	NA	NA	NA	NA	4.7 J	NA	2.5	NA	NA	NA	NA	NA	NA	NA	20 J-
LCBSB02[2.5]	07/24/03	2.5	NA	< 2.9	NA	20	NA	NA	NA	NA	5.3	NA	2.2	NA	NA	NA	NA	NA	NA	NA	22
LCBSB03[1]	07/24/03	1	NA	< 2.7 UJ	NA	68	NA	NA	NA	NA	6.2 J	NA	4.3	NA	NA	NA	NA	NA	NA	NA	21 J-
LCBSB03[2.5]	07/24/03	2.5	NA	< 2.8 UJ	NA	38	NA	NA	NA	NA	8.9 J	NA	2.1	NA	NA	NA	NA	NA	NA	NA	23 J-
LCBSB04[0.3]	07/31/03	0.3	NA	< 3.4 UJ	NA	21	NA	NA	NA	NA	7.6	NA	29	NA	NA	NA	NA	NA	NA	NA	37
LCBSB04[1]	07/31/03	1	NA	< 3.1 UJ	NA	19	NA	NA	NA	NA	5.3	NA	64	NA	NA	NA	NA	NA	NA	NA	24
LCBSB05[0.3]	07/24/03	0.3	NA	< 2.9	NA	44	NA	NA	NA	NA	11	NA	13	NA	NA	NA	NA	NA	NA	NA	35
LCBSB05[1]	07/24/03	1	NA	< 3.1	NA	26	NA	NA	NA	NA	4.9	NA	8.5	NA	NA	NA	NA	NA	NA	NA	23
LCBSB06[1]	07/24/03	1	NA	< 2.9 UJ	NA	31	NA	NA	NA	NA	6.2 J	NA	1.5	NA	NA	NA	NA	NA	NA	NA	21 J-
LCBSB06[2]	07/24/03	2	NA	< 2.8 UJ	NA	30	NA	NA	NA	NA	5.6 J	NA	4.9	NA	NA	NA	NA	NA	NA	NA	21 J-
LCBSB07[1]	07/24/03	1	4,100	< 2.7	1.8	30	< 0.09	0.85	27	4.7	6.7	7,800	5.1	1,800	180	21	< 0.22	< 0.22	< 0.22	19	24
LCBSB07[2]	07/24/03	2	NA	< 2.6	NA	28	NA	NA	NA	NA	6.8	NA	3.8	NA	NA	NA	NA	NA	NA	NA	25
LCBSB08[0.3]	07/24/03	0.3	NA	< 2.7	NA	18	NA	NA	NA	NA	4.7	NA	22	NA	NA	NA	NA	NA	NA	NA	27
LCBSB08[1]	07/24/03	1	NA	< 2.9	NA	13	NA	NA	NA	NA	3.8	NA	2	NA	NA	NA	NA	NA	NA	NA	17
LCBSB09[0.3]	07/31/03	0.3	NA	< 3 UJ	NA	40	NA	NA	NA	NA	11	NA	23	NA	NA	NA	NA	NA	NA	NA	28
LCBSB09[1]	07/31/03	1	NA	< 2.7 UJ	NA	20	NA	NA	NA	NA	4.3	NA	5.6	NA	NA	NA	NA	NA	NA	NA	17
LCBSB10[0.5]	07/24/03	0.5	NA	< 2.8	NA	16	NA	NA	NA	NA	3.7	NA	3.4	NA	NA	NA	NA	NA	NA	NA	23
LCBSB10[1.5]	07/24/03	1.5	NA	< 3	NA	32	NA	NA	NA	NA	8.2	NA	6.7	NA	NA	NA	NA	NA	NA	NA	24
LCBSB11[0.3]	07/24/03	0.3	NA	< 2.9	NA	15	NA	NA	NA	NA	3.2	NA	3.7	NA	NA	NA	NA	NA	NA	NA	19
LCBSB11[1]	07/24/03	1	NA	< 2.9	NA	18	NA	NA	NA	NA	4.9	NA	1.8	NA	NA	NA	NA	NA	NA	NA	33
LCBSB12[0.3]	07/31/03	0.3	NA	< 2.7 UJ	NA	14	NA	NA	NA	NA	3.3	NA	6.2	NA	NA	NA	NA	NA	NA	NA	16
LCBSB12[1]	07/31/03	1	NA	< 2.6 UJ	NA	12	NA	NA	NA	NA	2.8	NA	5.4	NA	NA	NA	NA	NA	NA	NA	14
LCBSB13[0.3]	07/24/03	0.3	NA	< 2.5	NA	12	NA	NA	NA	NA	2.6	NA	0.74	NA	NA	NA	NA	NA	NA	NA	15
LCBSB13[1]	07/24/03	1	NA	< 2.7	NA	14	NA	NA	NA	NA	3.5	NA	4	NA	NA	NA	NA	NA	NA	NA	19
LCBSB14[0.3]	07/24/03	0.3	NA	< 2.3	NA	23	NA	NA	NA	NA	4.9	NA	5.4	NA	NA	NA	NA	NA	NA	NA	19
LCBSB14[1]	07/24/03	1	NA	< 3.6	NA	8.3	NA	NA	NA	NA	2.4	NA	3.7	NA	NA	NA	NA	NA	NA	NA	14
LCBSB15[1]	07/24/03	1	NA	< 2.9	NA	16	NA	NA	NA	NA	3.3	NA	4.1	NA	NA	NA	NA	NA	NA	NA	19
LCBSB15[2]	07/24/03	2	NA	< 3.2	NA	23	NA	NA	NA	NA	5.6	NA	5.7	NA	NA	NA	NA	NA	NA	NA	22
DUP072403C	07/24/03	2.5	NA	< 3.1	NA	14	NA	NA	NA	NA	3.3	NA	1.9	NA	NA	NA	NA	NA	NA	NA	17
LCBSB16[0.3]	07/24/03	0.3	NA	< 2.8	NA	16	NA	NA	NA	NA	3	NA	3.8	NA	NA	NA	NA	NA	NA	NA	23
LCBSB16[1]	07/24/03	1	NA	< 2.6	NA	15	NA	NA	NA	NA	3.3	NA	3.8	NA	NA	NA	NA	NA	NA	NA	18
LCBSB17[0.3]	07/31/03	0.3	NA	< 2.8 UJ	NA	17	NA	NA	NA	NA	4.9	NA	21 J+	NA	NA	NA	NA	NA	NA	NA	25
LCBSB17[1]	07/31/03	1	NA	< 2.8 UJ	NA	12	NA	NA	NA	NA	3.3	NA	7.6 J+	NA	NA	NA	NA	NA	NA	NA	22
LCBSB18[1]	07/30/03	1	NA	< 2.9 UJ	NA	12	NA	NA	NA	NA	3.2	NA	28 J+	NA	NA	NA	NA	NA	NA	NA	16
DUP073003E	07/30/03	0.5	NA	< 3 UJ	NA	11	NA	NA	NA	NA	3.6	NA	23 J+	NA	NA	NA	NA	NA	NA	NA	16
LCBSB18[2]	07/30/03	2	3,500	< 2.3 UJ	1.9	11	0.25	0.64	23	3.1	1.9	6,600	6.1	1,400 J-	83 J-	16	< 0.19	< 0.19	< 0.19	16	11
LCBSB19[1]	07/24/03	1	NA	< 2.9 UJ	NA	8.4	NA	NA	NA	NA	3.1 J+	NA	8.4	NA	NA	NA	NA	NA	NA	NA	13
LCBSB19[2]	07/24/03	2	NA	< 2.8 UJ	NA	7.2	NA	NA	NA	NA	1.9 J+	NA	0.51	NA	NA	NA	NA	NA	NA	NA	9.8

Table B-1
Summary of Metals Results in Soil
Lobos Creek Target Butt
Small Arms Firing Ranges
Presidio of San Francisco, California

			Aluminum (mg/kg)	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Magnesium (mg/kg)	Manganese (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Thallium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)
		Analytical Method	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020
Cleanup Level			**NE**	**5**	**5.9**	**320**	**10**	**1.7**	**120**	**20**	**43**	**NE**	**160**	**NE**	**NE**	**70**	**0.75**	**2**	**1**	**92**	**66**
Sample Name	**Sample Date**	**Sample Depth (feet)**																			
LCBSB20[1]	07/30/03	1	NA	< 3 UJ	NA	13	NA	NA	NA	NA	3.8	NA	23 J+	NA	NA	NA	NA	NA	NA	NA	16
DUP073003D	07/30/03	0.5	NA	< 2.7 UJ	NA	11	NA	NA	NA	NA	3.1	NA	19 J+	NA	NA	NA	NA	NA	NA	NA	13
LCBSB20[2][MSD]	07/30/03	2	NA	< 2.3 UJ	NA	9.8	NA	NA	NA	NA	2.7	NA	14 J+	NA	NA	NA	NA	NA	NA	NA	12
LCBSB21[1]	07/24/03	1	NA	< 2.8 UJ	NA	14	NA	NA	NA	NA	3.2 J+	NA	5.9	NA	NA	NA	NA	NA	NA	NA	17
DUP072403A	07/24/03	1.5	NA	< 2.7 UJ	NA	15	NA	NA	NA	NA	5.2 J+	NA	27	NA	NA	NA	NA	NA	NA	NA	18
LCBSB21[2]	07/24/03	2	NA	< 2.9 UJ	NA	13	NA	NA	NA	NA	4.3 J+	NA	20	NA	NA	NA	NA	NA	NA	NA	17
LCBSB22[1]	07/31/03	1	NA	< 3.1 UJ	NA	14	NA	NA	NA	NA	6.7	NA	28	NA	NA	NA	NA	NA	NA	NA	17
LCBSB22[2]	07/31/03	2	NA	< 2.6 UJ	NA	10	NA	NA	NA	NA	3.8	NA	17	NA	NA	NA	NA	NA	NA	NA	13
LCBSB23[1]	07/24/03	1	NA	< 2.7 UJ	NA	12	NA	NA	NA	NA	3.5	NA	0.71	NA	NA	NA	NA	NA	NA	NA	12 J+
LCBSB23[2]	07/24/03	2	NA	< 2.8 UJ	NA	12	NA	NA	NA	NA	1.9	NA	0.26	NA	NA	NA	NA	NA	NA	NA	11 J+
LCBSB24[1]	07/24/03	1	NA	< 2.7 UJ	NA	110	NA	NA	NA	NA	**56**	NA	6.2	NA	NA	NA	NA	NA	NA	NA	17 J+
DUP072403B	07/24/03	1.5	NA	< 3.5 UJ	NA	21	NA	NA	NA	NA	3.1	NA	0.48	NA	NA	NA	NA	NA	NA	NA	19 J+
LCBSB24[2.5]	07/24/03	2.5	NA	< 2.7 UJ	NA	13	NA	NA	NA	NA	2.2	NA	0.23	NA	NA	NA	NA	NA	NA	NA	13 J+
LCBSB25[1]	07/31/03	1	NA	< 3 UJ	NA	17	NA	NA	NA	NA	4.9	NA	34	NA	NA	NA	NA	NA	NA	NA	21 J-
LCBSB25[2]	07/31/03	2	NA	< 2.9 UJ	NA	19	NA	NA	NA	NA	6.5	NA	49	NA	NA	NA	NA	NA	NA	NA	27 J-
LCBSB26[1][MSD]	07/31/03	1	NA	< 2.9 UJ	NA	12	NA	NA	NA	NA	3.6	NA	5.8	NA	NA	NA	NA	NA	NA	NA	15 J-
LCBSB26[2]	07/31/03	2	NA	< 2.4 UJ	NA	12	NA	NA	NA	NA	2.3	NA	2.1	NA	NA	NA	NA	NA	NA	NA	13 J-
DUP073103C	07/31/03	2.5	NA	< 2.9 UJ	NA	10	NA	NA	NA	NA	2.1	NA	1.9	NA	NA	NA	NA	NA	NA	NA	12 J-
LCBSB27[0.3]	07/24/03	0.3	NA	< 2.7 UJ	NA	10	NA	NA	NA	NA	2.2	NA	0.62	NA	NA	NA	NA	NA	NA	NA	13 J+
LCBSB27[1]	07/24/03	1	3,400	< 2.8 UJ	2.4	9.5	0.14	0.81	23	3.9	2.2	7,100	0.56	1,800	93	21	< 0.23	< 0.23	< 0.23	16	12 J+
LCBSB28[0.3]	07/24/03	0.3	NA	< 3 UJ	NA	9	NA	NA	NA	NA	2.3	NA	2.7	NA	NA	NA	NA	NA	NA	NA	14 J+
LCBSB28[1]	07/24/03	1	NA	< 2.8 UJ	NA	10	NA	NA	NA	NA	2.2	NA	0.76	NA	NA	NA	NA	NA	NA	NA	12 J+
LCBSB29[0.3]	07/24/03	0.3	NA	< 3 UJ	NA	8.4	NA	NA	NA	NA	2.3	NA	2.1	NA	NA	NA	NA	NA	NA	NA	13 J+
LCBSB29[1]	07/24/03	1	NA	< 2.9 UJ	NA	7.7	NA	NA	NA	NA	2.5	NA	0.69	NA	NA	NA	NA	NA	NA	NA	11 J+
LCBSB30[0.3]	07/31/03	0.3	NA	< 2.9 UJ	NA	29	NA	NA	NA	NA	11	NA	8.5	NA	NA	NA	NA	NA	NA	NA	18 J-
LCBSB30[1]	07/31/03	1	NA	< 2.8 UJ	NA	29	NA	NA	NA	NA	9.3	NA	7.8	NA	NA	NA	NA	NA	NA	NA	18 J-
DUP073103B	07/31/03	1.5	NA	< 2.6 UJ	NA	17	NA	NA	NA	NA	4.9	NA	3.7	NA	NA	NA	NA	NA	NA	NA	13 J-
LCBSB31[0.3]	07/24/03	0.3	NA	< 2.9 UJ	NA	12	NA	NA	NA	NA	4.6	NA	26	NA	NA	NA	NA	NA	NA	NA	19 J+
LCBSB31[1]	07/24/03	1	NA	< 2.7 UJ	NA	15	NA	NA	NA	NA	5	NA	27	NA	NA	NA	NA	NA	NA	NA	17 J+
LCBSB32[0.3][MSD]	07/24/03	0.3	4,100	< 2.9 UJ	2.7	17	< 0.097	1.3	30	4.2	5.6	10,000	33	1,800	130	21	0.69	< 0.24	< 0.24	21	55 J+
LCBSB32[1]	07/24/03	1	NA	< 2.6 UJ	NA	14	NA	NA	NA	NA	2.1	NA	2.7	NA	NA	NA	NA	NA	NA	NA	22 J+
LCBSB33[1]	07/24/03	1	NA	< 2.9 UJ	NA	40	NA	NA	NA	NA	19	NA	9.8	NA	NA	NA	NA	NA	NA	NA	14 J+
LCBSB33[2]	07/24/03	2	NA	< 2.8 UJ	NA	74	NA	NA	NA	NA	26	NA	23	NA	NA	NA	NA	NA	NA	NA	24 J+
LCBSB34[0.3]	07/31/03	0.3	NA	< 3 UJ	NA	15	NA	NA	NA	NA	4.5	NA	20	NA	NA	NA	NA	NA	NA	NA	26 J-
LCBSB34[1]	07/31/03	1	NA	< 2.8 UJ	NA	14	NA	NA	NA	NA	4.1	NA	22	NA	NA	NA	NA	NA	NA	NA	27 J-
LCBSB35[1]	07/24/03	1	NA	< 3 UJ	NA	17	NA	NA	NA	NA	6.7 J+	NA	21	NA	NA	NA	NA	NA	NA	NA	15
LCBSB35[2]	07/24/03	2	NA	< 2.9 UJ	NA	82	NA	NA	NA	NA	34	NA	19	NA	NA	NA	NA	NA	NA	NA	27 J+
LCBSB36[0.3]	07/31/03	0.3	NA	< 2.6 UJ	NA	23	NA	NA	NA	NA	8.3	NA	38 J+	NA	NA	NA	NA	NA	NA	NA	**94**
LCBSB36[1]	07/31/03	1	NA	< 2.7 UJ	NA	20	NA	NA	NA	NA	6.7	NA	25 J+	NA	NA	NA	NA	NA	NA	NA	**70**
DUP073103A	07/31/03	1.5	NA	< 2.6 UJ	NA	14	NA	NA	NA	NA	3.9	NA	12 J+	NA	NA	NA	NA	NA	NA	NA	33
LCBSB37[0.3]	07/24/03	0.3	NA	< 2.7 UJ	NA	32	NA	NA	NA	NA	13	NA	49	NA	NA	NA	NA	NA	NA	NA	42 J+

Table B-1
Summary of Metals Results in Soil
Lobos Creek Target Butt
Small Arms Firing Ranges
Presidio of San Francisco, California

			Aluminum (mg/kg)	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Magnesium (mg/kg)	Manganese (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Thallium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)
		Analytical Method	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020
Cleanup Level			**NE**	**5**	**5.9**	**320**	**10**	**1.7**	**120**	**20**	**43**	**NE**	**160**	**NE**	**NE**	**70**	**0.75**	**2**	**1**	**92**	**66**
Sample Name	**Sample Date**	**Sample Depth (feet)**																			
LCBSB37[1]	07/24/03	1	NA	< 2.9 UJ	NA	17	NA	NA	NA	NA	7.7 J+	NA	44	NA	NA	NA	NA	NA	NA	NA	50
LCBSB38[0.3]	07/31/03	0.3	3,500	< 2.8 UJ	1.6	10	0.26	0.67	22	2.9	22	6,600	7.9	1,500 J-	74 J-	15	< 0.23	< 0.23	< 0.23	15	31
LCBSB38[1][MSD]	07/31/03	1	4,100	< 3.6 UJ	1.9	11	0.32	0.78	26	3.5	3.3	7,300	11	1,800 J-	74 J-	19	< 0.3	< 0.3	< 0.3	19	39
LCBSB39[0.3]	07/30/03	0.3	NA	< 2.9 UJ	NA	14	NA	NA	NA	NA	11	NA	38 J+	NA	NA	NA	NA	NA	NA	NA	32
LCBSB39[1][MSD]	07/30/03	1	NA	< 2.5 UJ	NA	13	NA	NA	NA	NA	4.1	NA	34 J+	NA	NA	NA	NA	NA	NA	NA	34
LCBSB40[0.3]	07/30/03	0.3	5,000	< 4.6 UJ	2.2	21	0.45	0.95	36	4.6	21	7,700	44	2,500 J-	86 J-	24	< 0.38	0.72	< 0.38	32	44
LCBSB40[1]	07/30/03	1	NA	< 4.1 UJ	NA	14	NA	NA	NA	NA	11	NA	30 J+	NA	NA	NA	NA	NA	NA	NA	36
LCBSB41[0.3]	07/30/03	0.3	NA	< 3.2 UJ	NA	16	NA	NA	NA	NA	5.5	NA	35 J+	NA	NA	NA	NA	NA	NA	NA	37
LCBSB41[1]	07/30/03	1	NA	< 2.4 UJ	NA	14	NA	NA	NA	NA	3.6	NA	15 J+	NA	NA	NA	NA	NA	NA	NA	45
DUP073003C	07/30/03	1.5	NA	< 2.5 UJ	NA	13	NA	NA	NA	NA	3	NA	7.9 J+	NA	NA	NA	NA	NA	NA	NA	33
LCBSB42[0.3]	07/30/03	0.3	NA	< 2.5 UJ	NA	17	NA	NA	NA	NA	4.5	NA	24 J+	NA	NA	NA	NA	NA	NA	NA	33
LCBSB42[1]	07/30/03	1	NA	< 2.8 UJ	NA	14	NA	NA	NA	NA	4.1	NA	23 J+	NA	NA	NA	NA	NA	NA	NA	32

Notes
mg/kg - milligrams per kilogram
Dup prefix indicates blind duplicate sample.
MSD - Matrix spike duplicate
MSD indicates to the laboratory which samples were to be used for the MSD quality control sample analyses. These are not matrix spike results.
NA - Not analyzed
NE - Not established
BOLD values indicate concentration exceeding cleanup levels.
Cleanup levels were obtained from Table 7-2 of the Cleanup Levels Document (EKI, 2002).
J+ - Data validation qualifier, "The analyte was positively identified; the associated numerical value is biased high due to a high surrogate recovery and should be considered an approximate concentration of the analyte in the sample."
J- - Data validation qualifier, "The analyte was positively identified; the associated numerical values is biased low due to a low surrogate recovery and should be considered an approximate concentration of the analyte in the sample."
UJ - Data validation qualifier, "The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample."

Table B-2
Summary of Metals Results in Soil
Lobos Creek Protected Range
Small Arms Firing Ranges
Presidio of San Francisco, California

			Aluminum (mg/kg)	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Magnesium (mg/kg)	Manganese (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Thallium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)
		Analytical Method	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020
Cleanup Level			**NE**	**5**	**5.9**	**320**	**10**	**1.7**	**120**	**20**	**43**	**NE**	**160**	**NE**	**NE**	**70**	**0.75**	**2**	**1**	**92**	**66**
Location ID	**Sample ID**	**Sample Depth (feet)**																			
LCPSB01[0.3]	07/28/03	0.3	NA	< 2.7 UJ	NA	17	NA	NA	NA	NA	3.6 J-	NA	5.2 J-	NA	NA	NA	NA	NA	NA	NA	16
LCPSB01[1]	07/28/03	1	4,400	< 2.7 UJ	2.6	40	0.26	0.81	38	5.2	8.9 J-	8,800	7.8	2,600	210	30	< 0.23	< 0.23	< 0.23	24	30
LCPSB02[0.3]	07/28/03	0.3	NA	< 3 UJ	NA	16	NA	NA	NA	NA	3.2 J-	NA	3.4 J-	NA	NA	NA	NA	NA	NA	NA	16
LCPSB02[1]	07/28/03	1	NA	< 3 UJ	NA	21	NA	NA	NA	NA	4.7 J-	NA	21 J-	NA	NA	NA	NA	NA	NA	NA	18
LCPSB03[0.3]	07/28/03	0.3	NA	< 2.5 UJ	NA	15	NA	NA	NA	NA	3.1 J-	NA	2.7 J-	NA	NA	NA	NA	NA	NA	NA	14
LCPSB03[1]	07/28/03	1	NA	< 3 UJ	NA	17	NA	NA	NA	NA	3.3 J-	NA	3.1 J-	NA	NA	NA	NA	NA	NA	NA	15
LCPSB04[0.3]	07/28/03	0.3	NA	< 2.8 UJ	NA	23	NA	NA	NA	NA	6.5 J-	NA	7.1 J-	NA	NA	NA	NA	NA	NA	NA	21
LCPSB04[1]	07/28/03	1	NA	< 2.8 UJ	NA	16	NA	NA	NA	NA	3.9 J-	NA	7.4 J-	NA	NA	NA	NA	NA	NA	NA	21
LCPSB05[0.3]	07/28/03	0.3	NA	< 2.9 UJ	NA	44	NA	NA	NA	NA	4.4 J-	NA	3.1 J-	NA	NA	NA	NA	NA	NA	NA	15
LCPSB05[1]	07/28/03	1	NA	< 2.9 UJ	NA	21	NA	NA	NA	NA	3.7 J-	NA	8.8 J-	NA	NA	NA	NA	NA	NA	NA	19
LCPSB06[0.3]	08/04/03	0.3	NA	< 3	NA	21	NA	NA	NA	NA	5	NA	16	NA	NA	NA	NA	NA	NA	NA	23
LCPSB06[1]	08/04/03	1	NA	< 3	NA	20	NA	NA	NA	NA	5	NA	10	NA	NA	NA	NA	NA	NA	NA	19
LCPSB07[0.3]	08/04/03	0.3	NA	< 3	NA	32	NA	NA	NA	NA	7.9	NA	13	NA	NA	NA	NA	NA	NA	NA	24
LCPSB07[1]	08/04/03	1	NA	< 3	NA	17	NA	NA	NA	NA	4.1	NA	22	NA	NA	NA	NA	NA	NA	NA	18
LCPSB08[1]	08/01/03	1	NA	< 2.9 R	NA	10	NA	NA	NA	NA	2.7	NA	3.1 J-	NA	NA	NA	NA	NA	NA	NA	17 J-
DUP080103B	08/01/03	0.5	NA	< 3 R	NA	11	NA	NA	NA	NA	3.3	NA	3.6	NA	NA	NA	NA	NA	NA	NA	15
LCPSB08[2]	08/01/03	2	NA	< 2.6 R	NA	8.8	NA	NA	NA	NA	2.2	NA	2.5 J-	NA	NA	NA	NA	NA	NA	NA	14 J-
LCPSB09[1]	08/01/03	1	NA	< 2.7 R	NA	16	NA	NA	NA	NA	3.3	NA	9.2 J-	NA	NA	NA	NA	NA	NA	NA	20 J-
LCPSB09[2]	08/01/03	2	NA	< 2.4 R	NA	12	NA	NA	NA	NA	2.5	NA	4.5 J-	NA	NA	NA	NA	NA	NA	NA	17 J-
LCPSB10[1]	08/01/03	1	NA	< 2.4 R	NA	9.6	NA	NA	NA	NA	2.3	NA	1.9 J-	NA	NA	NA	NA	NA	NA	NA	15 J-
LCPSB10[2][MSD]	08/01/03	2	NA	< 2.7 UJ	NA	11	NA	NA	NA	NA	2.1	NA	1.6	NA	NA	NA	NA	NA	NA	NA	12
LCPSB11[1]	07/23/03	1	NA	< 3 UJ	NA	8.9	NA	NA	NA	NA	1.9	NA	0.35	NA	NA	NA	NA	NA	NA	NA	11
LCPSB11[2]	07/23/03	2	NA	< 2.9 UJ	NA	11	NA	NA	NA	NA	2.2	NA	0.42	NA	NA	NA	NA	NA	NA	NA	14
LCPSB12[1]	07/23/03	1	NA	< 2.8 UJ	NA	12	NA	NA	NA	NA	2.1	NA	0.37	NA	NA	NA	NA	NA	NA	NA	13
LCPSB12[2]	07/23/03	2	NA	< 2.8 UJ	NA	10	NA	NA	NA	NA	2	NA	0.43	NA	NA	NA	NA	NA	NA	NA	12
LCPSB13[1][MSD]	07/23/03	1	NA	< 2.5 UJ	NA	14	NA	NA	NA	NA	2.1	NA	0.53	NA	NA	NA	NA	NA	NA	NA	14
LCPSB13[2]	07/23/03	2	NA	< 2.9 UJ	NA	8.4	NA	NA	NA	NA	2	NA	0.37	NA	NA	NA	NA	NA	NA	NA	11
LCPSB14[1]	08/01/03	1	NA	< 2.7 UJ	NA	12	NA	NA	NA	NA	3.3	NA	13	NA	NA	NA	NA	NA	NA	NA	17
LCPSB14[2]	08/01/03	2	NA	< 3 UJ	NA	11	NA	NA	NA	NA	3	NA	9.3	NA	NA	NA	NA	NA	NA	NA	17
DUP080103A	08/01/03	2.5	NA	< 2.8 UJ	NA	12	NA	NA	NA	NA	3.4	NA	12	NA	NA	NA	NA	NA	NA	NA	19
LCPSB15[1]	07/31/03	1	NA	< 2.8 UJ	NA	12	NA	NA	NA	NA	3.4	NA	8.5	NA	NA	NA	NA	NA	NA	NA	17
DUP073103E	07/31/03	0.5	NA	< 2.5 UJ	NA	12	NA	NA	NA	NA	3.6	NA	11	NA	NA	NA	NA	NA	NA	NA	17
LCPSB15[2]	07/31/03	2	NA	< 2.9 UJ	NA	10	NA	NA	NA	NA	2.8	NA	6.3	NA	NA	NA	NA	NA	NA	NA	14
LCPSB16[1]	07/23/03	1	NA	< 2.9 UJ	NA	12	NA	NA	NA	NA	2.3	NA	0.49	NA	NA	NA	NA	NA	NA	NA	14
LCPSB16[2]	07/23/03	2	NA	< 3 UJ	NA	9.1	NA	NA	NA	NA	2.1	NA	0.22	NA	NA	NA	NA	NA	NA	NA	11
LCPSB17[1]	07/23/03	1	NA	< 2.8 UJ	NA	17	NA	NA	NA	NA	2.2	NA	0.69	NA	NA	NA	NA	NA	NA	NA	18
LCPSB17[2]	07/23/03	2	NA	< 3 UJ	NA	13	NA	NA	NA	NA	2.5	NA	0.54	NA	NA	NA	NA	NA	NA	NA	17
LCPSB18[0.3]	07/23/03	0.3	NA	< 2.7 UJ	NA	27	NA	NA	NA	NA	7.4	NA	66	NA	NA	NA	NA	NA	NA	NA	53
LCPSB18[1]	07/23/03	1	NA	< 2.9 UJ	NA	20	NA	NA	NA	NA	7.4 J+	NA	43	NA	NA	NA	NA	NA	NA	NA	39
LCPSB19[0.3]	07/23/03	0.3	NA	< 2.8 UJ	NA	7.2	NA	NA	NA	NA	3.5 J+	NA	2.6	NA	NA	NA	NA	NA	NA	NA	19
LCPSB19[1]	07/23/03	1	NA	< 2.9 UJ	NA	7.9	NA	NA	NA	NA	3.3 J+	NA	4.4	NA	NA	NA	NA	NA	NA	NA	16
LCPSB20[1]	07/23/03	1	4,200	< 2.9 UJ	1.9	10	< 0.096	0.94	34	4.2	2.4 J+	7,400	0.38	1,900 J+	97	21	< 0.24	< 0.24	< 0.24	20	12
LCPSB20[2.5]	07/23/03	2.5	NA	< 2.8 UJ	NA	25	NA	NA	NA	NA	9.7 J+	NA	2.2	NA	NA	NA	NA	NA	NA	NA	14
LCPSB21[1]	07/23/03	1	3,700	< 3 UJ	2	11	< 0.1	0.87	24	4.1	2.8 J+	7,000	2.8	1,700 J+	120	19	< 0.25	< 0.25	< 0.25	17	16
LCPSB21[2.5]	07/23/03	2.5	NA	< 2.9 UJ	NA	17	NA	NA	NA	NA	6.3 J+	NA	4.3	NA	NA	NA	NA	NA	NA	NA	17

Table B-2
Summary of Metals Results in Soil
Lobos Creek Protected Range
Small Arms Firing Ranges
Presidio of San Francisco, California

			Aluminum (mg/kg)	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Magnesium (mg/kg)	Manganese (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Thallium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)
		Analytical Method	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020
Cleanup Level			**NE**	**5**	**5.9**	**320**	**10**	**1.7**	**120**	**20**	**43**	**NE**	**160**	**NE**	**NE**	**70**	**0.75**	**2**	**1**	**92**	**66**
Location ID	**Sample ID**	**Sample Depth (feet)**																			
LCPSB22[1]	07/31/03	1	NA	< 3 UJ	NA	22	NA	NA	NA	NA	6.9	NA	31	NA	NA	NA	NA	NA	NA	NA	56
LCPSB23[1]	07/31/03	1.5	NA	< 2.6 UJ	NA	12	NA	NA	NA	NA	3.5	NA	5.4	NA	NA	NA	NA	NA	NA	NA	16
DUP073103D	07/31/03	1	NA	< 3.1 UJ	NA	16	NA	NA	NA	NA	6.9	NA	14	NA	NA	NA	NA	NA	NA	NA	32
LCPSB24[1]	07/23/03	1	NA	< 2.9 UJ	NA	18	NA	NA	NA	NA	3.9 J+	NA	19	NA	NA	NA	NA	NA	NA	NA	28
LCPSB24[2.5]	07/23/03	2.5	NA	< 3 UJ	NA	23	NA	NA	NA	NA	3.5 J+	NA	13	NA	NA	NA	NA	NA	NA	NA	23
LCPSB25[1.5]	07/23/03	1.5	NA	< 3 UJ	NA	10	NA	NA	NA	NA	2.8 J+	NA	2.4	NA	NA	NA	NA	NA	NA	NA	16
LCPSB25[2.5]	07/23/03	2.5	NA	< 2.8 UJ	NA	18	NA	NA	NA	NA	3.5 J+	NA	3.3	NA	NA	NA	NA	NA	NA	NA	14
LCPSB26[0.3]	07/31/03	0.3	NA	< 3 UJ	NA	16	NA	NA	NA	NA	4.4	NA	6.7	NA	NA	NA	NA	NA	NA	NA	17
LCPSB26[1]	07/31/03	1	NA	< 2.7 UJ	NA	14	NA	NA	NA	NA	3.9	NA	5.5	NA	NA	NA	NA	NA	NA	NA	17
LCPSB27[1]	07/23/03	1	NA	< 2.9 UJ	NA	19	NA	NA	NA	NA	6.7 J+	NA	14	NA	NA	NA	NA	NA	NA	NA	**110**
LCPSB27[2]	07/23/03	2	NA	< 2.9 UJ	NA	13	NA	NA	NA	NA	2.4 J+	NA	0.84	NA	NA	NA	NA	NA	NA	NA	11
LCPSB28[1]	07/23/03	1	NA	< 2.8 UJ	NA	17	NA	NA	NA	NA	3.9	NA	2.5	NA	NA	NA	NA	NA	NA	NA	15
LCPSB28[2]	07/23/03	2	NA	< 3.1 UJ	NA	11	NA	NA	NA	NA	2.5	NA	0.75	NA	NA	NA	NA	NA	NA	NA	11
LCPSB29[1]	07/23/03	1	NA	< 2.8 UJ	NA	16	NA	NA	NA	NA	3.2	NA	6.9	NA	NA	NA	NA	NA	NA	NA	19
LCPSB29[2]	07/23/03	2	NA	< 2.7 UJ	NA	9.7	NA	NA	NA	NA	2.1	NA	0.47	NA	NA	NA	NA	NA	NA	NA	13
LCPSB30[1]	07/23/03	1	NA	< 3 UJ	NA	14	NA	NA	NA	NA	3.1 J-	NA	0.36	NA	NA	NA	NA	NA	NA	NA	19 J-
LCPSB30[2]	07/23/03	2	NA	< 2.9 UJ	NA	11	NA	NA	NA	NA	2.5 J-	NA	0.81	NA	NA	NA	NA	NA	NA	NA	14
LCPSB31[1]	08/04/03	1	NA	< 2.8	NA	11	NA	NA	NA	NA	3.7	NA	7.2	NA	NA	NA	NA	NA	NA	NA	17
LCPSB31[2]	08/04/03	2	NA	< 3	NA	9.7	NA	NA	NA	NA	3.2	NA	6.9	NA	NA	NA	NA	NA	NA	NA	16
LCPSB32[1]	07/23/03	1	NA	< 3 UJ	NA	13	NA	NA	NA	NA	4.6 J-	NA	7.1	NA	NA	NA	NA	NA	NA	NA	15 J-
LCPSB32[2]	07/23/03	2	NA	< 2.9 UJ	NA	8.3	NA	NA	NA	NA	3 J-	NA	0.8	NA	NA	NA	NA	NA	NA	NA	13
LCPSB33[1]	08/04/03	1	NA	< 2.7	NA	9.1	NA	NA	NA	NA	13	NA	34	NA	NA	NA	NA	NA	NA	NA	14
LCPSB33[2]	08/04/03	2	NA	< 3	NA	11	NA	NA	NA	NA	28	NA	51	NA	NA	NA	NA	NA	NA	NA	14
DUP080403A	08/04/03	2.5	NA	< 2.9	NA	9.1	NA	NA	NA	NA	24	NA	60	NA	NA	NA	NA	NA	NA	NA	14
LCPSB34[1]	07/23/03	1	NA	< 3 UJ	NA	12	NA	NA	NA	NA	9.5 J-	NA	44	NA	NA	NA	NA	NA	NA	NA	13
LCPSB34[2]	07/23/03	2	NA	< 2.9 UJ	NA	11	NA	NA	NA	NA	2.3 J-	NA	0.42	NA	NA	NA	NA	NA	NA	NA	14
DUP072303A	07/23/03	1.5	NA	< 2.9 UJ	NA	12	NA	NA	NA	NA	2.4 J-	NA	0.48	NA	NA	NA	NA	NA	NA	NA	15 J-
LCPSB35[1]	07/23/03	1	3,400	< 3 UJ	2.2	11	< 0.1	0.68	20	3.9	29 J-	6,300	58	1,600	110	30 J-	0.57 J-	< 0.25	< 0.25	15	15 J-
LCPSB35[2]	07/23/03	2	NA	< 2.9 UJ	NA	9.8	NA	NA	NA	NA	9.2 J-	NA	26	NA	NA	NA	NA	NA	NA	NA	14
LCPSB36[1]	07/23/03	1	NA	< 2.7 UJ	NA	9.3	NA	NA	NA	NA	2	NA	0.67	NA	NA	NA	NA	NA	NA	NA	11
LCPSB36[2]	07/23/03	2	NA	< 2.9 UJ	NA	7	NA	NA	NA	NA	1.7	NA	0.39	NA	NA	NA	NA	NA	NA	NA	9.9
LCPSB37[1]	07/23/03	1	NA	< 2.8 UJ	NA	75	NA	NA	NA	NA	14	NA	3.5	NA	NA	NA	NA	NA	NA	NA	**85**
LCPSB37[2]	07/23/03	2	3,100	< 2.8 UJ	2	15	0.11	0.69	19	3.5	3	5,900	1.3	1,500 J+	97	19	< 0.23	< 0.23	< 0.23	14	12
DUP072303B	07/23/03	1.5	3,700	< 2.9 UJ	2.4	33	0.14	0.86	22	4.6	7.1	7,700	5.7	1,700 J+	180	22	< 0.24	< 0.24	< 0.24	16	18

Notes
mg/kg - milligrams per kilogram
Dup prefix indicates blind duplicate sample.
MSD - Matrix spike duplicate
MSD indicates to the laboratory which samples were to be used for the MSD quality control sample analyses. These are not matrix spike results.
NA - Not analyzed
NE - Not established
BOLD values indicate concentration exceeding cleanup levels.
Cleanup levels were obtained from Table 7-2 of the Cleanup Levels Document (EKI, 2002).
J+ - Data validation qualifier, "The analyte was positively identified; the associated numerical value is biased high due to a high surrogate recovery and should be considered an approximate concentration of the analyte in the sample."
J- - Data validation qualifier, "The analyte was positively identified; the associated numerical values is biased low due to a low surrogate recovery and should be considered an approximate concentration of the analyte in the sample."
UJ - Data validation qualifier, "The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample."
R - Data validation qualifier, "The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified."

Table B-3
Summary of Metals Results in Soil
Machine Gun Butt
Small Arms Firing Ranges
Presidio of San Francisco, California

			Aluminum (mg/kg)	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)		Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Magnesium (mg/kg)	Manganese (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Thallium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)
		Analytical Method	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020		SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020
Cleanup Level			**NE**	**5**	**5.4**	**320**	**10**	**0.8**		**120**	**48**	**43**	**NE**	**160**	**NE**	**NE**	**71**	**1.1**	**2**	**1**	**74**	**60**
Sample Name	**Sample Date**	**Sample Depth (feet)**						**ICP**	**ICP/MS**													
MGBSB02[1]	07/22/03	1	NA	< 3.5 UJ	NA	70	NA	NA	NA	NA	NA	15 J-	NA	27	NA	NA	NA	NA	NA	NA	NA	42 J-
MGBSB02[2]	07/22/03	2	NA	< 3.4 UJ	NA	65	NA	NA	NA	NA	NA	16 J-	NA	25	NA	NA	NA	NA	NA	NA	NA	50 J-
MGBSB03[1]	07/22/03	1	NA	< 2.9 R	NA	75	NA	NA	NA	NA	NA	12	NA	15	NA	NA	NA	NA	NA	NA	NA	53 J-
MGBSB03[2]	07/22/03	2	NA	< 2.9 R	NA	82	NA	NA	NA	NA	NA	29	NA	0.59	NA	NA	NA	NA	NA	NA	NA	39 J-
MGBSB04[1]	07/22/03	1	NA	< 2.8 R	NA	94	NA	NA	NA	NA	NA	15	NA	39	NA	NA	NA	NA	NA	NA	NA	**63**
DUP072203A	07/22/03	1.5	NA	< 3 R	NA	150	NA	NA	NA	NA	NA	21	NA	34	NA	NA	NA	NA	NA	NA	NA	**64 J-**
MGBSB04[2]	07/22/03	2	NA	< 3 R	NA	190	NA	NA	NA	NA	NA	25	NA	28	NA	NA	NA	NA	NA	NA	NA	57 J-
MGBSB05[1]	07/22/03	1	NA	< 2.7 R	NA	49	NA	NA	NA	NA	NA	10	NA	29	NA	NA	NA	NA	NA	NA	NA	43
MGBSB05[2]	07/22/03	2	NA	< 2.7 R	NA	58	NA	NA	NA	NA	NA	24	NA	200	NA	NA	NA	NA	NA	NA	NA	33
MGBSB06[1]	07/22/03	1	6,100	< 2.8 R	3	35	0.11	**1.2**	< 0.25	50	7.6	6.6	9,900	15	38,00 J+	190	54	0.34	< 0.23	< 0.23	28	34
MGBSB06[2]	07/22/03	2	NA	< 2.6 R	NA	52	NA	NA	NA	NA	NA	7.7	NA	10	NA	NA	NA	NA	NA	NA	NA	30
MGBSB07[1]	07/22/03	1	NA	< 2.9 UJ	NA	30	NA	NA	NA	NA	NA	5.7 J-	NA	3	NA	NA	NA	NA	NA	NA	NA	20 J-
MGBSB07[2]	07/22/03	2	NA	< 3.2 UJ	NA	21	NA	NA	NA	NA	NA	9 J-	NA	< 0.16	NA	NA	NA	NA	NA	NA	NA	24 J-
MGBSB08[1]	07/22/03	1	NA	< 2.9 UJ	NA	67	NA	NA	NA	NA	NA	6.7 J-	NA	19	NA	NA	NA	NA	NA	NA	NA	23 J-
MGBSB08[2]	07/22/03	2	NA	< 2.8 UJ	NA	12	NA	NA	NA	NA	NA	2.8 J-	NA	0.39	NA	NA	NA	NA	NA	NA	NA	13
MGBSB09[1]	07/22/03	1	NA	< 3.1 UJ	NA	23	NA	NA	NA	NA	NA	5.1 J-	NA	19	NA	NA	NA	NA	NA	NA	NA	24 J-
MGBSB09[2]	07/22/03	2	NA	< 3.1 UJ	NA	16	NA	NA	NA	NA	NA	3 J-	NA	1.6	NA	NA	NA	NA	NA	NA	NA	15 J-
MGBSB10[1]	07/22/03	1	NA	< 3.1 UJ	NA	24	NA	NA	NA	NA	NA	4 J-	NA	6.8	NA	NA	NA	NA	NA	NA	NA	16 J-
MGBSB10[2]	07/22/03	2	NA	< 2.9 UJ	NA	42	NA	NA	NA	NA	NA	6.6 J-	NA	36	NA	NA	NA	NA	NA	NA	NA	29 J-
MGBSB11[1]	07/21/03	1	NA	< 2.8 R	NA	56	NA	NA	NA	NA	NA	9.3	NA	19	NA	NA	NA	NA	NA	NA	NA	28
MGBSB11[2]	07/21/03	2	NA	< 2.4 R	NA	91	NA	NA	NA	NA	NA	13	NA	3.1	NA	NA	NA	NA	NA	NA	NA	30
MGBSB12[1]	07/21/03	1	NA	< 2.6 R	NA	41	NA	NA	NA	NA	NA	8.4	NA	32	NA	NA	NA	NA	NA	NA	NA	29
MGBSB12[2]	07/21/03	2	NA	< 2.6 R	NA	26	NA	NA	NA	NA	NA	4.4	NA	10	NA	NA	NA	NA	NA	NA	NA	23
MGBSB13[1]	07/21/03	1	NA	< 2.7 R	NA	83	NA	NA	NA	NA	NA	13	NA	15	NA	NA	NA	NA	NA	NA	NA	30
MGBSB14[0.5]	07/21/03	0.5	NA	< 2.8 R	NA	110	NA	NA	NA	NA	NA	17	NA	9.9	NA	NA	NA	NA	NA	NA	NA	37
MGBSB14[1]	07/21/03	1	NA	< 2.9 R	NA	79	NA	NA	NA	NA	NA	14	NA	13	NA	NA	NA	NA	NA	NA	NA	28
MGBSB15[1]	07/21/03	1	NA	< 2.8 R	NA	60	NA	NA	NA	NA	NA	9.2	NA	11	NA	NA	NA	NA	NA	NA	NA	33
MGBSB16[1]	07/21/03	1	8,200	< 2.9 R	2.9	89	0.23	**1.7**	< 0.25	55	12	11	15,000	8.5	2,900 J+	340	59	1	< 0.24	< 0.24	40	35
MGBSB16[2]	07/21/03	2	NA	< 2.9 R	NA	71	NA	NA	NA	NA	NA	11	NA	1.4	NA	NA	NA	NA	NA	NA	NA	27
MGBSB17[1]	07/21/03	1	NA	< 2.8 R	NA	95	NA	NA	NA	NA	NA	12	NA	30	NA	NA	NA	NA	NA	NA	NA	41
MGBSB17[2]	07/21/03	2	NA	< 2.9 R	NA	100	NA	NA	NA	NA	NA	11	NA	5.3	NA	NA	NA	NA	NA	NA	NA	36
MGBSB18[1]	07/21/03	1	NA	< 3 R	NA	58	NA	NA	NA	NA	NA	9.1	NA	6.3	NA	NA	NA	NA	NA	NA	NA	25
MGBSB18[2]	07/21/03	2	NA	< 2.6 R	NA	31	NA	NA	NA	NA	NA	4.2	NA	0.29	NA	NA	NA	NA	NA	NA	NA	19
MGBSB19[0.3]	07/21/03	0.3	NA	< 3 R	NA	57	NA	NA	NA	NA	NA	21	NA	120	NA	NA	NA	NA	NA	NA	NA	**76**

Notes
mg/kg - milligrams per kilogram
Dup prefix indicates blind duplicate sample.
ICP - inductively coupled plasma
MS - mass spectrometry
NA - Not analyzed
NE - Not established
BOLD values indicate concentration exceeding cleanup levels.
Cleanup levels were obtained from Table 7-2 of the Cleanup Levels Document (EKI, 2002).
J+ - Data validation qualifier, "The analyte was positively identified; the associated numerical value is biased high due to a high surrogate recovery and should be considered an approximate concentration of the analyte in the sample."
J- - Data validation qualifier, "The analyte was positively identified; the associated numerical values is biased low due to a low surrogate recovery and should be considered an approximate concentration of the analyte in the sample."
UJ - Data validation qualifier, "The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample."
R - Data validation qualifier, "The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified."

Table B-4
Summary of Metals Results
California Highway Patrol Pistol Range
Small Arms FiringRanges
Presidio of San Francisco, California

			Aluminum (mg/kg)	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)		Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	STLC Lead (µg/L)	TCLP Lead (µg/L)	Magnesium (mg/kg)	Manganese (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Thallium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)
		Analytical Method	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020		SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ WET	SW6010/ TCLP	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020
Cleanup or Regulatory Level			**NE**	**5**	**5.9**	**320**	**10**	**0.8**		**120**	**20**	**43**	**NE**	**160**	**5,000**	**5,000**	**NE**	**NE**	**70**	**0.5**	**2**	**1**	**90**	**60**
Sample Name	**Sample Date**	**Sample Depth (feet)**						**ICP**	**ICP/MS**															
CHPSB01[0.3]	07/30/03	0.3	NA	< 2.8 UJ	NA	90	NA	NA	NA	NA	NA	36	NA	120	NA	NA	NA	NA	NA	NA	NA	NA	NA	59
CHPSB01[1]	07/30/03	1	NA	< 3.2 UJ	NA	60	NA	NA	NA	NA	NA	11	NA	25	NA	NA	NA	NA	NA	NA	NA	NA	NA	46
CHPSB01[2]	07/30/03	2	NA	< 3.2 UJ	NA	65	NA	NA	NA	NA	NA	4.9	NA	5.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	19
CHPSB02[0.3]	07/30/03	0.3	3,800	< 3 UJ	1.6	73	0.25	**1.1**	NA	31	5.4	22	9,000	**180**	**15,000**	NA	1,700	420	25	< 0.25	< 0.25	0.27	19	**110**
CHPSB02[1]	07/30/03	1	NA	< 3 UJ	NA	54	NA	NA	NA	NA	NA	11	NA	33	NA	NA	NA	NA	NA	NA	NA	NA	NA	42
CHPSB02[2][MSD]	07/30/03	2	NA	< 3.1 UJ	NA	59	NA	NA	NA	NA	NA	5.3	NA	8.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	20
CHPSB03[0.3]	07/30/03	0.3	NA	< 3 UJ	NA	64	NA	NA	NA	NA	NA	7.9	NA	**220**	**12,000**	NA	NA	NA	NA	NA	NA	NA	NA	**70**
CHPSB03[1]	07/30/03	1	NA	< 2.4 UJ	NA	52	NA	NA	NA	NA	NA	3.9	NA	16	NA	NA	NA	NA	NA	NA	NA	NA	NA	19
CHPSB03[2]	07/30/03	2	NA	< 3.1 UJ	NA	33	NA	NA	NA	NA	NA	3.3	NA	13 J+	NA	NA	NA	NA	NA	NA	NA	NA	NA	18
DUP073003B	07/30/03	2.5	NA	< 2.6 UJ	NA	36	NA	NA	NA	NA	NA	4	NA	11 J+	NA	NA	NA	NA	NA	NA	NA	NA	NA	17
CHPSB05[1]	07/29/03	1	NA	4.6 J-	NA	44 J-	NA	NA	NA	NA	NA	31	NA	**1,000**	**100,000**	**6,100**	NA	NA	NA	NA	NA	NA	NA	**63 J-**
CHPSB06[1]	07/29/03	1	NA	3.7 J-	NA	56 J-	NA	NA	NA	NA	NA	37	NA	**4,700**	**330,000**	**22,000**	NA	NA	NA	NA	NA	NA	NA	**110 J-**
CHPSB06[2]	07/29/03	2	NA	< 3.1 UJ	NA	54 J-	NA	NA	NA	NA	NA	5.7	NA	19	NA	NA	NA	NA	NA	NA	NA	NA	NA	21 J-
CHPSB06[3]	07/29/03	3	NA	< 2.8 UJ	NA	27 J-	NA	NA	NA	NA	NA	3.5	NA	5.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	18 J-
CHPSB07[1]	07/29/03	1	NA	**29 J-**	NA	39 J-	NA	NA	NA	NA	NA	**58**	NA	**6,000**	**480,000**	**100,000**	NA	NA	NA	NA	NA	NA	NA	**67 J-**
CHPSB07[2]	07/29/03	2	NA	2.9 J-	NA	42 J-	NA	NA	NA	NA	NA	14	NA	**470**	**49,000**	NA	NA	NA	NA	NA	NA	NA	NA	28 J-
CHPSB07[3]	07/29/03	3	NA	< 2.8 UJ	NA	28 J-	NA	NA	NA	NA	NA	9.8	NA	**260**	**31,000**	NA	NA	NA	NA	NA	NA	NA	NA	23 J-
DUP072903D	07/29/03	2.5	NA	< 2.7 UJ	NA	29 J-	NA	NA	NA	NA	NA	5.6	NA	74	NA	NA	NA	NA	NA	NA	NA	NA	NA	16 J-
CHPSB08[1]	07/29/03	1	4,500	< 2.8 UJ	2	33	0.15	**0.81**	NA	29	4.2	5.1	7,400	61	NA	NA	1,700	120	22	< 0.24	< 0.24	< 0.24	20	28
CHPSB08[2]	07/29/03	2	NA	< 2.7 UJ	NA	28 J-	NA	NA	NA	NA	NA	4.6	NA	42	NA	NA	NA	NA	NA	NA	NA	NA	NA	23 J-
CHPSB09[2]	07/29/03	2	NA	< 2.9 UJ	NA	34	NA	NA	NA	NA	NA	4.2 J-	NA	9.4 J-	NA	NA	NA	NA	NA	NA	NA	NA	NA	19
DUP072903A	07/29/03	1.5	NA	< 2.6 UJ	NA	34	NA	NA	NA	NA	NA	4.7 J-	NA	4.7 J-	NA	NA	NA	NA	NA	NA	NA	NA	NA	15
CHPSB09[3]	07/29/03	3	4,100	< 2.9 UJ	1.9	17	< 0.098	0.6	NA	28	3.6	3.8 J-	6,600	6.3	NA	NA	1,700	81	21	0.32	< 0.24	< 0.24	17	15
CHPSB09[4]	07/29/03	4	5,500	< 2.7 UJ	2.2	25	0.15	0.77	NA	30	4.7	3.8 J-	8,200	3	NA	NA	2,100	100	27	< 0.23	< 0.23	< 0.23	23	15
CHPSB10[2]	07/29/03	2	4,200	< 2.4 UJ	2	18	0.098	0.61	NA	27	4	2.7 J-	6,500	2.1	NA	NA	1,800	89	23	< 0.2	< 0.2	< 0.2	18	13
DUP072903B	07/29/03	2.5	4,600	< 2.8 UJ	2.1	18	0.11	0.68	NA	30	4.4	3 J-	7,300	2	NA	NA	1,900	110	23	< 0.23	< 0.23	0.43	22	14
CHPSB10[3]	07/29/03	3	NA	< 2.7 UJ	NA	18	NA	NA	NA	NA	NA	2.9	NA	6.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	14
CHPSB10[4]	07/29/03	4	NA	< 3.1 UJ	NA	18	NA	NA	NA	NA	NA	2.6	NA	9.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	13
CHPSB11[1]	07/30/03	1	NA	< 2.7 UJ	NA	20	NA	NA	NA	NA	NA	3.9	NA	23	NA	NA	NA	NA	NA	NA	NA	NA	NA	34
DUP073003A	07/30/03	0.5	NA	< 2.9 UJ	NA	24	NA	NA	NA	NA	NA	4.9	NA	51	NA	NA	NA	NA	NA	NA	NA	NA	NA	45
CHPSB11[2]	07/30/03	2	NA	< 2.8 UJ	NA	23	NA	NA	NA	NA	NA	3.3	NA	14	NA	NA	NA	NA	NA	NA	NA	NA	NA	21
CHPSB11[3][MSD]	07/30/03	3	NA	< 3 UJ	NA	31	NA	NA	NA	NA	NA	4.3	NA	25	NA	NA	NA	NA	NA	NA	NA	NA	NA	25
CHPSB12[1]	07/30/03	1	NA	< 2.7 UJ	NA	31	NA	NA	NA	NA	NA	4.5	NA	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	29
CHPSB12[2]	07/30/03	2	3,700	< 2.8 UJ	1.6	34	0.2	**0.97**	NA	31	4	4.7	9,700	17	NA	NA	1,500	120	21	< 0.23	< 0.23	< 0.23	26	18
CHPSB12[3]	07/30/03	3	4,200	< 2.7 UJ	1.7	49	0.28	**1.9**	NA	52	4.3	5.8	19,000	17	NA	NA	1,500	130	31	< 0.22	< 0.22	< 0.22	51	19
CHPSB13[1]	07/30/03	1	NA	< 2.4 UJ	NA	49	NA	NA	NA	NA	NA	6	NA	20	NA	NA	NA	NA	NA	NA	NA	NA	NA	28
CHPSB13[2]	07/30/03	2	NA	< 3 UJ	NA	52	NA	NA	NA	NA	NA	6.9	NA	5.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	34
CHPSB13[3]	07/30/03	3	NA	< 2.6 UJ	NA	54	NA	NA	NA	NA	NA	7.6	NA	5.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	23
CHPSB14[1]	07/29/03	1	NA	< 2.3 UJ	NA	35 J-	NA	NA	NA	NA	NA	4.5	NA	14	NA	NA	NA	NA	NA	NA	NA	NA	NA	24 J-
CHPSB14[2]	07/29/03	2	NA	< 2.7 UJ	NA	36 J-	NA	NA	NA	NA	NA	4.3	NA	8.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	19 J-
CHPSB14[3]	07/29/03	3	NA	< 2.5 UJ	NA	27 J-	NA	NA	NA	NA	NA	3.3	NA	3.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	16 J-
CHPSB15[1]	07/29/03	1	NA	< 3 UJ	NA	55 J-	NA	NA	NA	NA	NA	8.7	NA	54	NA	NA	NA	NA	NA	NA	NA	NA	NA	43 J-
CHPSB15[2]	07/29/03	2	NA	< 2.6 UJ	NA	34 J-	NA	NA	NA	NA	NA	4.7	NA	33	NA	NA	NA	NA	NA	NA	NA	NA	NA	23 J-
CHPSB15[3]	07/29/03	3	NA	< 3.2 UJ	NA	50 J-	NA	NA	NA	NA	NA	7.2	NA	45	NA	NA	NA	NA	NA	NA	NA	NA	NA	39 J-
CHPSB16[0.3]	07/29/03	0.3	NA	< 3 UJ	NA	51	NA	NA	NA	NA	NA	7.8	NA	130	NA	NA	NA	NA	NA	NA	NA	NA	NA	54
CHPSB16[1]	07/29/03	1	NA	< 2.9 UJ	NA	30	NA	NA	NA	NA	NA	4.1	NA	8.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	18
CHPSB16[2]	07/29/03	2	NA	< 2.7 UJ	NA	24	NA	NA	NA	NA	NA	4.1	NA	12	NA	NA	NA	NA	NA	NA	NA	NA	NA	16
DUP072903C	07/29/03	1.5	NA	< 2.9 UJ	NA	30	NA	NA	NA	NA	NA	4.8	NA	41	NA	NA	NA	NA	NA	NA	NA	NA	NA	25
CHPSB17[2]	07/29/03	2	NA	< 3 UJ	NA	21 J-	NA	NA	NA	NA	NA	3.4	NA	6.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	15 J-

Table B-4
Summary of Metals Results
California Highway Patrol Pistol Range
Small Arms FiringRanges
Presidio of San Francisco, California

			Aluminum (mg/kg)	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)		Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	STLC Lead (µg/L)	TCLP Lead (µg/L)	Magnesium (mg/kg)	Manganese (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Thallium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)
		Analytical Method	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020		SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ WET	SW6010/ TCLP	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020
Cleanup or Regulatory Level			**NE**	**5**	**5.9**	**320**	**10**	**0.8**		**120**	**20**	**43**	**NE**	**160**	**5,000**	**5,000**	**NE**	**NE**	**70**	**0.5**	**2**	**1**	**90**	**60**
Sample Name	**Sample Date**	**Sample Depth (feet)**						**ICP**	**ICP/MS**															
CHPSB17[3]	07/29/03	3	NA	< 2.8 UJ	NA	16 J-	NA	NA	NA	NA	NA	2.6	NA	3.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	13 J-
CHPSB18[0.3]	07/29/03	0.3	NA	< 2.8 UJ	NA	41	NA	NA	NA	NA	NA	6 J-	NA	81 J-	NA	NA	NA	NA	NA	NA	NA	NA	NA	47
CHPSB18[1]	07/29/03	1	NA	< 3 UJ	NA	40	NA	NA	NA	NA	NA	6 J-	NA	69 J-	NA	NA	NA	NA	NA	NA	NA	NA	NA	46
CHPSB18[2]	07/29/03	2	NA	< 2.9 UJ	NA	31	NA	NA	NA	NA	NA	4.2 J-	NA	10 J-	NA	NA	NA	NA	NA	NA	NA	NA	NA	18
CHPSB19[2]	07/29/03	2	3,700	< 2.9 UJ	1.5	27	0.17	0.69	NA	29	3.6	3.8	6,600	18	NA	NA	1,500	110	19	< 0.25	< 0.25	< 0.25	18	25
CHPSB19[3]	07/29/03	3	NA	< 2.6 UJ	NA	24 J-	NA	NA	NA	NA	NA	3.5	NA	10	NA	NA	NA	NA	NA	NA	NA	NA	NA	22 J-
CHPSB19[4]	07/29/03	4	3,500	< 2.7 UJ	1.8	17	0.17	0.63	NA	24	3.5	2.5	6,200	7.9	NA	NA	1,500	98	19	< 0.22	< 0.22	< 0.22	16	16
CHPSB20[1]	07/29/03	1	NA	< 2.8 UJ	NA	46 J-	NA	NA	NA	NA	NA	11	NA	15	NA	NA	NA	NA	NA	NA	NA	NA	NA	**73 J-**
CHPSB20[2]	07/29/03	2	NA	< 2.6 UJ	NA	57	NA	NA	NA	NA	NA	11	NA	25	NA	NA	NA	NA	NA	NA	NA	NA	NA	43
CHPSB20[3]	07/29/03	3	NA	< 3.1 UJ	NA	61	NA	NA	NA	NA	NA	6.8	NA	38	NA	NA	NA	NA	NA	NA	NA	NA	NA	32
CHPSB21[0.3]	07/25/03	0.3	NA	< 2.8 UJ	NA	35	NA	NA	NA	NA	NA	4.4 J	NA	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	16 J-
CHPSB21[1]	07/25/03	1	NA	< 3.4 UJ	NA	57	NA	NA	NA	NA	NA	6.2 J	NA	0.61	NA	NA	NA	NA	NA	NA	NA	NA	NA	20 J-
CHPSB21[2.5]	07/25/03	2.5	NA	< 3.4 UJ	NA	85	NA	NA	NA	NA	NA	16 J	NA	< 0.17	NA	NA	NA	NA	NA	NA	NA	NA	NA	31 J-
CHPSB22[0.3]	07/25/03	0.3	5,200	< 2.8	2.3	28	< 0.094	**1**	< 0.25	38	4.7	3.9	9,100	5.4	NA	NA	1,800	140	25	< 0.24	< 0.24	< 0.24	24	22
CHPSB22[1]	07/25/03	1	NA	< 3.2 UJ	NA	58	NA	NA	NA	NA	NA	5.7 J	NA	0.76	NA	NA	NA	NA	NA	NA	NA	NA	NA	18 J-
CHPSB22[2.5]	07/25/03	2.5	NA	< 2.5 UJ	NA	42	NA	NA	NA	NA	NA	4.4 J	NA	0.34	NA	NA	NA	NA	NA	NA	NA	NA	NA	17 J-
CHPSB23[0.3]	07/25/03	0.3	NA	< 2.9 UJ	NA	71	NA	NA	NA	NA	NA	22 J	NA	25	NA	NA	NA	NA	NA	NA	NA	NA	NA	37 J-
CHPSB23[1]	07/25/03	1	NA	< 2.8 UJ	NA	34	NA	NA	NA	NA	NA	5.3 J	NA	29	NA	NA	NA	NA	NA	NA	NA	NA	NA	55 J-
CHPSB23[2.5]	07/25/03	2.5	NA	< 3.1 UJ	NA	37	NA	NA	NA	NA	NA	5.5 J	NA	24	NA	NA	NA	NA	NA	NA	NA	NA	NA	**77 J-**
CHPSB24[0.3]	07/25/03	0.3	NA	< 2.4 UJ	NA	44	NA	NA	NA	NA	NA	**140 J**	NA	29	NA	NA	NA	NA	NA	NA	NA	NA	NA	**120 J-**
CHPSB24[1]	07/25/03	1	NA	< 2.7 UJ	NA	41	NA	NA	NA	NA	NA	6 J	NA	15	NA	NA	NA	NA	NA	NA	NA	NA	NA	**70 J-**
CHPSB24[2.5]	07/25/03	2.5	NA	< 3.5 UJ	NA	29	NA	NA	NA	NA	NA	3.9 J	NA	0.97	NA	NA	NA	NA	NA	NA	NA	NA	NA	17 J-
CHPSB25[1]	07/25/03	1	4,200	< 3.1	2.4	25	< 0.1	**1**	NA	36	4.2	9.8	9,300	50	NA	NA	1,700	120	21	< 0.26	< 0.26	< 0.26	26	40
DUP072503A	07/25/03	0.5	4,200	< 2.7	2.1	26	< 0.089	**1**	NA	36	4.1	7.8	9,400	53	NA	NA	1,700	120	21	< 0.22	< 0.22	< 0.22	26	38
CHPSB25[2]	07/25/03	2	NA	< 3 UJ	NA	33	NA	NA	NA	NA	NA	5.2 J	NA	11	NA	NA	NA	NA	NA	NA	NA	NA	NA	32 J-
CHPSB25[3]	07/25/03	3	NA	< 3 UJ	NA	30	NA	NA	NA	NA	NA	3.5 J	NA	3.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	29 J-
CHPSB26[1]	07/25/03	1	NA	< 3.2 UJ	NA	37	NA	NA	NA	NA	NA	5.3 J	NA	16	NA	NA	NA	NA	NA	NA	NA	NA	NA	35 J-
CHPSB26[3]	07/25/03	3	NA	< 2.8 UJ	NA	82	NA	NA	NA	NA	NA	6.8 J	NA	5.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	27 J-
CHPSB27[1]	07/29/03	1	NA	< 3.1 UJ	NA	53	NA	NA	NA	NA	NA	15	NA	64	NA	NA	NA	NA	NA	NA	NA	NA	NA	**93**
CHPSB27[2][MSD]	07/29/03	2	NA	< 2.9 UJ	NA	64 J-	NA	NA	NA	NA	NA	8.6	NA	4.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	**61 J-**
CHPSB27[3]	07/29/03	3	NA	< 2.9 UJ	NA	43	NA	NA	NA	NA	NA	8.9	NA	4.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	**83**

Notes
mg/kg - milligrams per kilogram
µg/L - micrograms per liter
Dup prefix indicates blind duplicate sample.
ICP - inductively coupled plasma
MS - mass spectrometry
MSD - Matrix spike duplicate
MSD indicates to the laboratory which samples were to be used for the MSD quality control sample analyses. These are not matrix spike results.
NA - Not analyzed
NE - Not established
STLC - Soluble Threshold Limit Concentration
TCLP - Toxicity Characteristic Leaching Procedure
BOLD values indicate concentration exceeding cleanup or regulatory levels.
Cleanup levels were obtained from Table 7-2 of the Cleanup Levels Document (EKI, 2002).
J- - Data validation qualifier, "The analyte was positively identified; the associated numerical values is biased low due to a low surrogate recovery and should be considered an approximate concentration of the analyte in the sample."
UJ - Data validation qualifier, "The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample."
J+ - Data validation qualifier, "The analyte was positively identified; the associated numerical value is biased high due to a high surrogate recovery and should be considered an approximate concentration of the analyte in the sample."
J - Data validation qualifier, "The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample."

Table B-5
Summary of Metals Results in Soil
Barnard Avenue Protected Range
Small Arms Firing Ranges
Presidio of San Francisco, California

			Aluminum (mg/kg)	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)		Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	STLC Lead (µg/L)	Magnesium (mg/kg)	Manganese (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Thallium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)
		Analytical Method	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020		SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ WET	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020	SW6010/ 6020
Cleanup or Regulatory Level			**NE**	**5**	**5.4**	**320**	**10**	**0.8**		**120**	**20**	**43**	**NE**	**160**	**5,000**	**NE**	**NE**	**70**	**0.5**	**2**	**1**	**74**	**60**
Sample Name	**Sample Date**	**Sample Depth (feet)**						**ICP**	**ICP/MS**														
BAPSB01[4.5][MSD]	07/25/03	4.5	NA	< 2.9 R	NA	170	NA	NA	NA	NA	NA	15	NA	3.3	NA	NA	NA	NA	NA	NA	NA	NA	38 J-
BAPSB01[5.5]	07/25/03	5.5	NA	< 3.3 R	NA	88	NA	NA	NA	NA	NA	8.5	NA	1.6	NA	NA	NA	NA	NA	NA	NA	NA	21 J-
BAPSB02[3]	07/25/03	3	NA	< 2.8 R	NA	130	NA	NA	NA	NA	NA	15	NA	27	NA	NA	NA	NA	NA	NA	NA	NA	**81 J-**
DUP072503B	07/25/03	3.5	NA	< 3.1 R	NA	170	NA	NA	NA	NA	NA	18	NA	18	NA	NA	NA	NA	NA	NA	NA	NA	**73 J-**
BAPSB02[5.5]	07/25/03	5.5	NA	< 3.1 R	NA	96	NA	NA	NA	NA	NA	6.4	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	14 J-
BAPSB03R[5.5]	08/01/03	5.5	NA	< 3.1 UJ	NA	140 J-	NA	NA	NA	NA	NA	23 J-	NA	**230 J-**	< 1,500	NA	NA	NA	NA	NA	NA	NA	**200 J-**
BAPSB03R[6.5]	08/01/03	6.5	NA	< 3.1 UJ	NA	100 J-	NA	NA	NA	NA	NA	7.8 J-	NA	5.4 J-	NA	NA	NA	NA	NA	NA	NA	NA	28 J-
BAPSB04[1][MSD]	08/01/03	1	NA	< 2.9 UJ	NA	140 J-	NA	NA	NA	NA	NA	14 J-	NA	67 J-	NA	NA	NA	NA	NA	NA	NA	NA	**100 J-**
DUP080103D	08/01/03	1.5	NA	< 2.6 UJ	NA	56 J-	NA	NA	NA	NA	NA	7.1 J-	NA	13 J-	NA	NA	NA	NA	NA	NA	NA	NA	38 J-
BAPSB04[3]	08/01/03	3	NA	< 2.8 UJ	NA	40 J-	NA	NA	NA	NA	NA	4.8 J-	NA	3.6 J-	NA	NA	NA	NA	NA	NA	NA	NA	20 J-
BAPSB05[7][MSD]	08/01/03	7	NA	< 3.4 UJ	NA	110 J-	NA	NA	NA	NA	NA	10 J-	NA	17 J-	NA	NA	NA	NA	NA	NA	NA	NA	33 J-
DUP080103F	08/01/03	7.5	NA	< 3.3 UJ	NA	110 J-	NA	NA	NA	NA	NA	9.6 J-	NA	9 J-	NA	NA	NA	NA	NA	NA	NA	NA	30 J-
BAPSB05[8.5]	08/01/03	8.5	NA	< 3.6 UJ	NA	94 J-	NA	NA	NA	NA	NA	6.9 J-	NA	5.4 J-	NA	NA	NA	NA	NA	NA	NA	NA	22 J-
BAPSB06[5.5]	07/25/03	5.5	NA	< 2.9 R	NA	110	NA	NA	NA	NA	NA	8.2	NA	4.3	NA	NA	NA	NA	NA	NA	NA	NA	25 J-
BAPSB07[5.5]	08/01/03	5.5	NA	< 2.7 UJ	NA	31 J-	NA	NA	NA	NA	NA	6.5 J-	NA	9.2 J-	NA	NA	NA	NA	NA	NA	NA	NA	23 J-
BAPSB08R[6.5]	08/01/03	6.5	NA	< 3.1	NA	60	NA	NA	NA	NA	NA	6.3	NA	2.6	NA	NA	NA	NA	NA	NA	NA	NA	21
BAPSB08R[7.5]	08/01/03	7.5	NA	< 3.2	NA	39	NA	NA	NA	NA	NA	5.8	NA	2.3	NA	NA	NA	NA	NA	NA	NA	NA	20
BAPSB09[0.3]	07/25/03	0.3	NA	< 2.3 R	NA	52	NA	NA	NA	NA	NA	6.5	NA	19	NA	NA	NA	NA	NA	NA	NA	NA	33 J-
BAPSB09[1]	07/25/03	1	NA	< 2.6 R	NA	30	NA	NA	NA	NA	NA	5.2	NA	< 0.13	NA	NA	NA	NA	NA	NA	NA	NA	22 J-
BAPSB10[1][MSD]	08/01/03	1	7200	< 2.9 R	1.8 J-	33	0.23	**1.2 J-**	< 0.25	50 J-	8.8 J-	5.6	12,000	12 J-	NA	2,100 J-	250	39 J-	< 0.24 UJ	< 0.24	< 0.24 UJ	29 J-	30 J-
BAPSB10[2]	08/01/03	2	NA	< 2.9 UJ	NA	31 J-	NA	NA	NA	NA	NA	3.7 J-	NA	3 J-	NA	NA	NA	NA	NA	NA	NA	NA	18 J-
BAPSB11[2]	07/25/03	2	NA	< 2.7 R	NA	69	NA	NA	NA	NA	NA	5.2	NA	0.89	NA	NA	NA	NA	NA	NA	NA	NA	24 J-
BAPSB11[3]	08/01/03	3	NA	< 2.7	NA	60	NA	NA	NA	NA	NA	6	NA	22	NA	NA	NA	NA	NA	NA	NA	NA	27
BAPSB12[1]	08/01/03	1	590	< 2.9 R	2.5 J-	35	0.19	**1.1 J-**	< 0.25	56 J-	7.2 J-	8.8	1,100	15 J-	NA	680 J-	180	70 J-	< 0.24 UJ	< 0.24	< 0.24 UJ	24 J-	21 J-
DUP080103C	08/01/03	1.5	6700	< 2.5 R	2.8 J-	38	0.22	**1.2 J-**	< 0.25	60 J-	6.9 J-	8.4	12,000	16 J-	NA	5,500 J-	180	58 J-	< 0.21 UJ	< 0.21	< 0.21 UJ	29 J-	23 J-
BAPSB12[3]	08/01/03	3	NA	< 2.6 UJ	NA	34 J-	NA	NA	NA	NA	NA	8.3 J-	NA	18 J-	NA	NA	NA	NA	NA	NA	NA	NA	30 J-
BAPSB13[0.3]	07/28/03	0.3	7700	< 3.1 UJ	3	98	0.37	**1.7**	< 0.25	57	11	19	14,000	160	NA	3,600	360	68	< 0.26	< 0.26	< 0.26	39	**210**
BAPSB13[1]	07/28/03	1	6800	< 3.3 UJ	2.2	77	0.3	**1.3**	< 0.25	52	9.8	12	13,000	39	NA	2,700	430	49	< 0.28	< 0.28	< 0.28	31	48
BAPSB14[0.3]	07/28/03	0.3	NA	< 3 UJ	NA	57	NA	NA	NA	NA	NA	11 J-	NA	36 J-	NA	NA	NA	NA	NA	NA	NA	NA	48
BAPSB14[1][MSD]	07/28/03	1	NA	< 3.3 UJ	NA	37	NA	NA	NA	NA	NA	6.7	NA	6.1	NA	NA	NA	NA	NA	NA	NA	NA	31
BAPSB15[0.3]	07/25/03	0.3	NA	< 2.8 R	NA	40	NA	NA	NA	NA	NA	6.1	NA	16	NA	NA	NA	NA	NA	NA	NA	NA	29 J-
BAPSB15[1]	07/25/03	1	NA	< 2.7 R	NA	30	NA	NA	NA	NA	NA	2.6	NA	0.23	NA	NA	NA	NA	NA	NA	NA	NA	18 J-
BAPSB16[0.3][MSD]	08/01/03	0.3	NA	< 3 UJ	NA	41 J-	NA	NA	NA	NA	NA	5.7 J-	NA	5.3 J-	NA	NA	NA	NA	NA	NA	NA	NA	25 J-
BAPSB16[1]	08/01/03	1	NA	< 2.9 UJ	NA	38 J-	NA	NA	NA	NA	NA	4.7 J-	NA	4.8 J-	NA	NA	NA	NA	NA	NA	NA	NA	20 J-
DUP080103E	08/01/03	1.5	NA	< 3 UJ	NA	55 J-	NA	NA	NA	NA	NA	6.8 J-	NA	24 J-	NA	NA	NA	NA	NA	NA	NA	NA	29 J-
BAPSB17[0.3][MSD]	07/28/03	0.3	NA	< 3.1 UJ	NA	48	NA	NA	NA	NA	NA	9.4 J-	NA	44 J-	NA	NA	NA	NA	NA	NA	NA	NA	41
BAPSB17[1]	07/28/03	1.5	NA	< 3 UJ	NA	41	NA	NA	NA	NA	NA	6.5 J-	NA	11 J-	NA	NA	NA	NA	NA	NA	NA	NA	31
DUP072803A	07/28/03	1	NA	< 3.1 UJ	NA	31	NA	NA	NA	NA	NA	7.5 J-	NA	91 J-	NA	NA	NA	NA	NA	NA	NA	NA	22
BAPSB18[0.3]	07/28/03	0.3	NA	< 3.1 UJ	NA	81	NA	NA	NA	NA	NA	**70 J-**	NA	150 J-	NA	NA	NA	NA	NA	NA	NA	NA	**350**
BAPSB18[1]	07/28/03	1	NA	< 3.2 UJ	NA	58	NA	NA	NA	NA	NA	13 J-	NA	52 J-	NA	NA	NA	NA	NA	NA	NA	NA	**98**

Notes
mg/kg - milligrams per kilogram
µg/L - micrograms per liter
Dup prefix indicates blind duplicate sample.
MSD - Matrix spike duplicate
MSD indicates to the laboratory which samples were to be used for the MSD quality control sample analyses. These are not matrix spike results.
NA - Not analyzed
NE - Not established
STLC - Soluble Threshold Limit Concentration
BOLD values indicate concentration exceeding cleanup or regulatory levels.
Cleanup levels were obtained from Table 7-2 of the Cleanup Levels Document (EKI, 2002).
ICP - inductively coupled plasma
MS - mass spectrometry
J- - Data validation qualifier, "The analyte was positively identified; the associated numerical values is biased low due to a low surrogate recovery and should be considered an approximate concentration of the analyte in the sample."
UJ - Data validation qualifier, "The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample."
R - Data validation qualifier, "The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified."

APPENDIX C

Cost Estimates and Assumptions

APPENDIX C

COST ESTIMATES AND ASSUMPTIONS FOR REMEDIAL ACTION ALTERNATIVES SMALL ARMS FIRING RANGES FEASIBILITY STUDY

Remedial action costs for the four alternative groupings are presented in Tables C-1 through C-6. These estimates have an accuracy level of +50 percent to –30 percent in accordance with U.S. Environmental Protection Agency (EPA) guidance (EPA, 1988b). For all alternatives, the costs are presented in present value. The level of accuracy for these estimates is appropriate for comparing corrective action alternatives and not necessarily accurate prediction of incurred cost. The cost estimate basis is a conceptual design rather than a detailed design. Notes and assumptions used for estimating the costs are on each table. Table C-7 presents unit rates used in the cost estimates. Table C-8 presents material surface area and volume estimates. These cost estimates include direct costs, indirect costs, and contingency. Direct costs include the labor, equipment, and materials required to complete the project or task. Indirect costs include general conditions (i.e., mobilization, site supervision, etc.), overhead and profit, project management, and escalation factors for the time between contract award and project start date. Estimated legal costs, administrative costs, contingencies, and mobilization costs are consistent with those presented in the cost estimates (Appendix E) for the *Presidio Trust Revised Feasibility Study Main Installations Sites* (EKI, 2003).

Table C-1
CHP and BAPR - Alternative 1:
Estimated Costs for No Further Action
Small Arms Firing Ranges
Presidio of San Francisco, California

No costs associated with this alternative

Table C-2
CHP and BAPR - Alternative 2:
Estimated Costs for Land Use Controls
Small Arms Firing Ranges
Presidio of San Francisco, California

Capital Costs					
	Estimated Costs				
Task Description	**Unit**	**Quantity**	**Unit Cost**	**Subtotal**	**Total**
Land Use Controls - CHP (Area A)					
[Estimated]	site	1	$ 5,500	$ 5,500	
					$ 5,500
Land Use Controls - BAPR (Area B)					
Prepare Site-Specific Addendum to the Land Use Control Master Reference Report	site	1	$ 5,000	$ 5,000	
Add Site-Specific Land Use Controls to Trust GIS System	site	1	$ 500	$ 500	
					$ 5,500
Project Management/Administration	ls	1	$ 1,000	$ 1,000	
					$ 1,000
Subtotal Estimated Costs (w/ contractor overhead and profit):					$ 12,000
Legal and Administrative Costs (assumed to be 5% of subtotal estimated costs w/ contractor overhead and profit):					$ 600
Subtotal Estimated Costs (w/ legal and administrative costs):					$ 12,600
Contingencies (assumed to be 20% of subtotal estimated costs w/ legal and administrative costs):					$ 2,500
Total Preliminary Estimated Capital Costs of Remedial Alternative:					**$ 15,100**

Annual Costs					
	Estimated Costs				
Task Description	**Unit**	**Quantity**	**Unit Cost**	**Subtotal**	**Total**
Inspect and Clear Vegetation from Drainage Ditches, Other Areas	ls	1	$ 1,000	$ 1,000	
					$ 1,000
Project Management/Administration					
Annual administrative cost of Land Use Controls	ls	1	$ 1,000	$ 1,000	
Coordinate with NPS for Area A site	ls	1	$ 1,000	$ 1,000	
Annualized cost of Five-Year Review (6 occurrences)	ls	1	$ 5,000	$ 5,000	
					$ 7,000
Subtotal Estimated Costs (w/ contractor overhead and profit):					$ 8,000
Legal and Administrative Costs (assumed to be 5% of subtotal estimated costs w/ contractor overhead and profit):					$ 400
Subtotal Estimated Costs (w/ legal and administrative costs):					$ 8,400
Contingencies (assumed to be 20% of subtotal estimated costs w/ legal and administrative costs):					$ 1,700
Total Preliminary Estimated Annual Costs of Remedial Alternative:					**$ 10,100**

Notes and Assumptions
1. Totals may not sum exactly because of rounding.
2. Derivation of unit rates is presented in Table C-7.

Table C-3
California Highway Patrol - Alternative 3:
Estimated Costs for Capping
Small Arms Firing Ranges
Presidio of San Francisco, California

Capital Costs					
	Estimated Costs				
Task Description	**Unit**	**Quantity**	**Unit Cost**	**Subtotal**	**Total**
General Site Preparation					
Mobilize contractor equipment and supplies to site	ls	1	$ 1,000	$ 1,000	
Erect and maintain perimeter temporary fence	ft	632	$ 10.00	$ 6,320	
Cap Area and Confirmation Sample Surveys	area	1	$ 6,000	$ 6,000	
Decontamination area for personnel and equipment	ls	1	$ 1,500	$ 1,500	
Provide Personnel Protective Equipment (PPE)	ls	1	$ 2,000	$ 2,000	
					$ 16,820
Data-gaps Investigation, to Confirm Extent of Cap					
Prepare additional characterization work plan	ls	1	$ 10,000	$ 10,000	
Collect soil confirmation samples with hand auger	loc	4	$ 200	$ 800	
Metals (Sb, Cu, Pb, and Zn) by EPA Method 6010	ea	19	$ 125	$ 2,375	
Perform independent data validation	ea	19	$ 20	$ 380	
Input analytical results into Presidio database	ea	19	$ 15	$ 285	
					$ 13,840
Repair Asphalt Areas					
Asphalt Sealing	sy	400	$ 1.25	$ 500	
Site Stabilization and Vegetation Replacement					
Import and Place Clean Topsoil (12 inches)	cy	102	$ 30	$ 3,052	
Vegetatation Replacement (Serpentinite scrub plants)	acre	0.06	$ 89,500	$ 5,644	
Furnish and install erosion control measures	sf	2,747	$ 0.333	$ 915	
					$ 10,111
Land Use Controls - CHP (Area A)					
[Estimated]	site	1	$ 5,500	$ 5,500	
					$ 5,500
NPS Section 106 Consultation	1s	1	$ 3,000	$ 3,000	
					$ 3,000
Design and Construction Management Services					
Engineering					
Perform general planning activities	ls	1	$ 10,000	$ 10,000	
Prepare remedial design	ls	1	$ 10,000	$ 10,000	
Bid, award, and negotiate construction contract	ls	1	$ 2,500	$ 2,500	
Construction observation					
Provide resident engineer	wk	1	$ 5,000	$ 5,000	
Provide office support	wk	1	$ 2,000	$ 2,000	
Provide vehicles and equipment	wk	1	$ 1,300	$ 1,300	
Perform air monitoring	wk	1	$ 1,000	$ 1,000	
Prepare Construction Report	ls	1	$ 25,000	$ 25,000	
Prepare Data-gaps Investigation Report	ls	1	$ 10,000	$ 10,000	
					$ 66,800
Engineering Project Management					
9% of Design and Construction Management Services		9%			$ 6,012
Subtotal Estimated Costs (w/ contractor overhead and profit):					$ 122,000
Legal and Administrative Costs (assumed to be 5% of subtotal estimated costs w/ contractor overhead and profit):					$ 6,000
Subtotal Estimated Costs (w/ legal and administrative costs):					$ 128,000
Contingencies (assumed to be 20% of subtotal estimated costs w/ legal and administrative costs):					$ 26,000
Total Preliminary Estimated Capital Costs of Remedial Alternative:					**$ 154,000**

Table C-3
California Highway Patrol - Alternative 3:
Estimated Costs for Capping
Small Arms Firing Ranges
Presidio of San Francisco, California

Annual Costs					
	Estimated Costs				
Task Description	**Unit**	**Quantity**	**Unit Cost**	**Subtotal**	**Total**
Inspect and Clear Vegetation from Drainage Ditches, Other Areas	ls	1	$ 1,000	$ 1,000	
Repair Damage to Permeable Cover	ls	1	$ 1,000	$ 1,000	
					$ 2,000
Project Management/Administration					
Annual administrative cost of Land Use Controls	ls	1	$ 1,000	$ 1,000	
Coordinate with NPS for Area A site	ls	1	$ 1,000	$ 1,000	
Annualized cost of Five-Year Review (6 occurrences)	ls	1	$ 5,000	$ 5,000	
					$ 7,000
Subtotal Estimated Costs (w/ contractor overhead and profit):					$ 9,000
Legal and Administrative Costs (assumed to be 5% of subtotal estimated costs w/ contractor overhead and profit):					$ 500
Subtotal Estimated Costs (w/ legal and administrative costs):					$ 9,500
Contingencies (assumed to be 20% of subtotal estimated costs w/ legal and administrative costs):					$ 1,900
Total Preliminary Estimated Annual Costs of Remedial Alternative:					**$ 11,400**

Notes and Assumptions

1. Totals may not sum exactly because of rounding.
2. Field effort for field investigation and capping is assumed to be 5 days (total) in duration.
3. Area for re-vegetation is estimated from Figure 7. Areas and volumes are shown in Table C-8.
4. Locations of data gaps sampling are shown in Figure 7.
5. Derivation of unit rates is presented in Table C-7.

Table C-4
Barnard Avenue Protected Range - Alternative 3:
Estimated Costs for Capping
Small Arms Firing Ranges
Presidio of San Francisco, California

Capital Costs					
	Estimated Costs				
Task Description	**Unit**	**Quantity**	**Unit Cost**	**Subtotal**	**Total**
General Site Preparation					
Mobilize contractor equipment and supplies to site	ls	1	$ 1,000	$ 1,000	
Erect and maintain perimeter temporary fence	ft	746	$ 10.00	$ 7,460	
Cap Area and Confirmation Sample Surveys	area	1	$ 6,000	$ 6,000	
Decontamination area for personnel and equipment	ls	1	$ 1,500	$ 1,500	
Provide Personnel Protective Equipment (PPE)	ls	1	$ 2,000	$ 2,000	
					$ 17,960
Data-gaps Investigation, to Confirm Extent of Cap					
Prepare additional characterization work plan	ls	1	$ 5,000	$ 5,000	
Collect soil confirmation samples with hand auger	loc	5	$ 200	$ 1,000	
Metals (Cu, Pb, and Zn) by EPA Method 6010	ea	19	$ 65	$ 1,235	
Perform independent data validation	ea	19	$ 20	$ 380	
Input analytical results into Presidio database	ea	19	$ 15	$ 285	
					$ 7,900
Repair Permeable Cover					
Asphalt Sealing	sy	87	$ 1.25	$ 109	
Site Stabilization and Vegetation Replacement					
Import and Place Clean Topsoil (12 inches)	cy	276	$ 30	$ 8,269	
Vegetation Replacement (Riparian scrub)	acre	0.17	$ 52,200	$ 8,918	
Furnish and install erosion control measures	sf	7,442	$ 0.333	$ 2,478	
					$ 19,774
Land Use Controls, Area B (Buildings 808 and 809)					
Prepare Site-Specific Addendum to the Land Use Control Master Reference Report	site	1	$ 5,000	$ 5,000	
Add Site-Specific Land Use Controls to Trust GIS System	site	1	$ 500	$ 500	
					$ 5,500
Design and Construction Management Services					
Engineering					
Perform general planning activities	ls	1	$ 10,000	$ 10,000	
Prepare remedial design	ls	1	$ 10,000	$ 10,000	
Bid, award, and negotiate construction contract	ls	1	$ 2,500	$ 2,500	
Construction observation					
Provide resident engineer	wk	1	$ 5,000	$ 5,000	
Provide office support	wk	1	$ 2,000	$ 2,000	
Provide vehicles and equipment	wk	1	$ 1,300	$ 1,300	
Perform air monitoring	wk	1	$ 1,000	$ 1,000	
Prepare Construction Report	ls	1	$ 25,000	$ 25,000	
Prepare Data-gaps Investigation Report	ls	1	$ 10,000	$ 10,000	
					$ 66,800
Engineering Project Management					
9% of Design and Construction Management Services		9%			$ 6,012
Subtotal Estimated Costs (w/ contractor overhead and profit):					$ 106,000
Legal and Administrative Costs (assumed to be 5% of subtotal estimated costs w/ contractor overhead and profit):					$ 5,000
Subtotal Estimated Costs (w/ legal and administrative costs):					$ 111,000
Contingencies (assumed to be 20% of subtotal estimated costs w/ legal and administrative costs):					$ 22,000
Total Preliminary Estimated Capital Costs of Remedial Alternative:					**$ 133,000**

Table C-4
Barnard Avenue Protected Range - Alternative 3:
Estimated Costs for Capping
Small Arms Firing Ranges
Presidio of San Francisco, California

Annual Costs					
	Estimated Costs				
Task Description	**Unit**	**Quantity**	**Unit Cost**	**Subtotal**	**Total**
Inspect and Clear Vegetation from Drainage Ditches, Other Areas	ls	1	$ 1,000	$ 1,000	
Repair Damage to Permeable Cover	ls	1	$ 1,000	$ 1,000	
					$ 2,000
Project Management/Administration					
Annual administrative cost of Land Use Controls	ls	1	$ 1,000	$ 1,000	
Annualized cost of Five-Year Review (6 occurrences)	ls	1	$ 5,000	$ 5,000	
					$ 6,000
Subtotal Estimated Costs (w/ contractor overhead and profit):					$ 8,000
Legal and Administrative Costs (assumed to be 5% of subtotal estimated costs w/ contractor overhead and profit):					$ 400
Subtotal Estimated Costs (w/ legal and administrative costs):					$ 8,400
Contingencies (assumed to be 20% of subtotal estimated costs w/ legal and administrative costs):					$ 1,700
Total Preliminary Estimated Annual Costs of Remedial Alternative:					**$ 10,100**

Notes and Assumptions

1. Totals may not sum exactly because of rounding.
2. Field effort for capping is assumed to be 1 week in duration.
3. Areas are estimated from Figure 8. Areas and volumes are listed in Table C-8.
4. Locations of data gaps sampling are shown in Figure 8.
5. Derivation of unit rates is presented in Table C-7.

Table C-5
California Highway Patrol -Alternative 4:
Estimated Costs to Excavate and Dispose of Soil
Small Arms Firing Ranges
Presidio of San Francisco, CA

Capital Costs					
	Estimated Costs				
Task Description	**Unit**	**Quantity**	**Unit Cost**	**Subtotal**	**Total**
General Site Preparation					
Mobilize contractor equipment and supplies to site	ls	1	$ 1,000	$ 1,000	
Erect and maintain perimeter temporary fence	ft	632	$ 10.00	$ 6,320	
Pre-excavation, post-excavation, and confirmation sample survey	area	1	$ 6,000	$ 6,000	
Decontamination area for personnel and equipment	ls	1	$ 1,500	$ 1,500	
Provide Personnel Protective Equipment (PPE)	ls	1	$ 2,000	$ 2,000	
					$ 16,820
Excavate Waste and Soil					
Break and remove asphalt, recycle off-site	sf	3,959	$ 1.00	$ 3,959	
Excavate soil, no segregation (3 cy bucket)	cy	563	$ 3.50	$ 1,971	
Bunker Excavation (limited access)	cy	35	$ 100.00	$ 3,500	
Load excavated material into end-dumps	cy	598	$ 4.00	$ 2,392	
Collect soil profile samples for disposal	ea	2	$ 26.00	$ 52	
Disposal characterization					
Six metals (EPA Method 6010B)	ea	2	$ 125	$ 250	
Total Extractable Petroleum Hydrocarbons (EPA 8015M), gas and diesel	ea	2	$ 140	$ 280	
Dispose of hazardous soil at Class I facility	ton	326	$ 150	$ 48,960	
Dispose of non-hazardous soil at Class II facility	ton	630	$ 35.00	$ 22,064	
					$ 83,427
Site Stabilization and Vegetation Replacement					
Import and Place Clean Topsoil	cy	102	$ 30.00	$ 3,052	
Restore Historical Berm (hand work)	1s	1	$ 2,500	$ 2,500	
Restore Asphalt	sf	3,599	$ 2.25	$ 8,098	
Vegetation Replacement (Serpentinite scrub plants)	acre	0.06	$ 89,500	$ 5,644	
Furnish and install erosion control measures	sf	2,747	$ 0.333	$ 915	
					$ 20,209
NPS Section 106 Consultation	1s	1	$ 3,000	$ 3,000	
					$ 3,000
Design and Construction Management Services					
Engineering					
Perform general planning activities	ls	1	$ 10,000	$ 10,000	
Prepare remedial design	ls	1	$ 10,000	$ 10,000	
Coordinate with waste management facilities	ls	1	$ 1,000	$ 1,000	
Bid, award, and negotiate construction contract	ls	1	$ 2,500	$ 2,500	
Construction observation					
Provide resident engineer	wk	1	$ 5,000	$ 5,000	
Provide office support	wk	1	$ 2,000	$ 2,000	
Provide vehicles and equipment	wk	1	$ 1,300	$ 1,300	
Perform air monitoring	wk	1	$ 1,000	$ 1,000	
Collect soil confirmation samples	ea	16	$ 26	$ 416	
Metals (Sb, Cu, Pb, and Zn) by EPA Method 6010	ea	16	$ 65	$ 1,040	
Perform independent data validation	ea	16	$ 20	$ 320	
Input analytical results into Presidio database	ea	16	$ 15	$ 240	
Prepare Excavation Report	ls	1	$ 25,000	$ 25,000	
					$ 59,816
Engineering Project Management					
9% of Design and Construction Management Services		9%			$ 5,383
Subtotal Estimated Costs (w/ contractor overhead and profit):					$ 189,000
Legal and Administrative Costs (assumed to be 5% of subtotal estimated costs w/ contractor overhead and profit):					$ 9,000
Subtotal Estimated Costs (w/ legal and administrative costs):					$ 200,000
Contingencies (assumed to be 20% of subtotal estimated costs w/ legal and administrative costs):					$ 40,000
Total Preliminary Estimated Capital Costs of Remedial Alternative:					**$ 240,000**

Table C-5
California Highway Patrol - Alternative 4:
Estimated Costs to Excavate and Dispose of Soil
Small Arms Firing Range
Presidio of San Francisco, CA

Notes and Assumptions

1. Totals may not sum exactly because of rounding.
2. Field effort for excavation is assumed to be 1 week in duration.
3. Areas of soil from Figure 7. Volumes are presented in Table C-8.
4. Approximately 35 cy of soil near the historical bunker will be excavated by hand.
5. Conversion factor from cy of soil to tons is 1.6 tons per cubic yard.
6. Conversion factor from cy of asphalt to tons is 1.7 tons per cubic yard.
7. Total volume of asphalt was increased by 10 percent to account for additional demolition during field effort.
8. Thickness of asphalt section is estimated to be 6 inches.
9. Sidewall confirmation samples will be collected at an approximate frequency of 1 sample per every 50 linear feet for a total of 13 samples. Samples will be analyzed for four metals (Sb, Cu, Pb, and Zn) (EPA 6010B).
10. Bottom confirmation samples will be collected at a frequency of 1 sample per 2,500 sf for a total of 3 samples. Samples will be analyzed for four metals (Sb, Cu, Pb, and Zn) (EPA 6010B).
11. Waste characterization samples will be collected approximately 1 per 500 cy. Samples will be analyzed for 6 Metals (Cd, Cr, Cu, Pb, Ni and Zn) (EPA 6010B), and total extractable petroluem hydrocarbons (EPA 8015M).
12. Lump sum cost is included for berm restoration, with specific activities to be determined.
13. Derivation of unit rates is presented in Table C-7.

Table C-6
Barnard Avenue Protected Range - Alternative 4:
Estimated Costs to Excavate and Dispose of Soil
Small Arms Firing Ranges
Presidio of San Francisco, CA

Capital Costs					
	Estimated Costs				
Task Description	**Unit**	**Quantity**	**Unit Cost**	**Subtotal**	**Total**
General Site Preparation					
Mobilize contractor equipment and supplies to site	ls	1	$ 1,000	$ 1,000	
Erect and maintain perimeter temporary fence	ft	746	$ 10.00	$ 7,460	
Remove 5' to 6' trees and save for replanting	ea	10	$ 48	$ 480	
Pre-excavation, post-excavation and confirmation sample survey	area	1	$ 6,000	$ 6,000	
Decontamination area for personnel and equipment	ls	1	$ 1,500	$ 1,500	
Provide Personnel Protective Equipment (PPE)	ls	1	$ 2,000	$ 2,000	
					$ 18,440
Excavate Waste and Soil					
Break and remove asphalt, recycle off-site	sf	860	$ 1.00	$ 860	
Excavate soil, no segregation (3 cy bucket)	cy	1,029	$ 3.50	$ 3,602	
Load excavated material into end-dumps	cy	1,029	$ 4.00	$ 4,116	
Collect soil profile samples for disposal	ea	4	$ 26.00	$ 104	
Disposal characterization					
Six metals (EPA Method 6010B)	ea	4	$ 125	$ 500	
Total Extractable Petroleum Hydrocarbons (EPA 8015M), gas and diesel	ea	4	$ 140	$ 560	
Dispose of non-hazardous soil at Class II facility	ton	1,646	$ 35.00	$ 57,624	
					$ 67,366
Site Stabilization and Vegetation Replacement					
Import and Place Clean Fill	cy	753	$ 20	$ 15,067	
Restore Asphalt	sf	782	$ 2.25	$ 1,760	
Import and Place Clean Topsoil (12 inches)	cy	276	$ 30	$ 8,269	
Vegetate Imported Cover (Riparian scrub)	acre	0.17	$ 52,200	$ 8,918	
Furnish and install erosion control measures	sf	7,442	$ 0.333	$ 2,478	
					$ 36,492
Land Use Controls, Area B (Buildings 808 and 809)					
Prepare Site-Specific Addendum to the Land Use Control Master Reference Report	site	1	$ 5,000	$ 5,000	
Add Site-Specific Land Use Controls to Trust GIS System	site	1	$ 500	$ 500	
					$ 5,500
Design and Construction Management Services					
Engineering					
Perform general planning activities	ls	1	$ 10,000	$ 10,000	
Prepare remedial design	ls	1	$ 10,000	$ 10,000	
Coordinate with waste management facilities	ls	1	$ 1,000	$ 1,000	
Bid, award, and negotiate construction contract	ls	1	$ 2,500	$ 2,500	
Construction observation					
Provide resident engineer	wk	1	$ 5,000	$ 5,000	
Provide office support	wk	1	$ 2,000	$ 2,000	
Provide vehicles and equipment	wk	1	$ 1,300	$ 1,300	
Perform air monitoring	wk	1	$ 1,000	$ 1,000	
Collect soil confirmation samples	ea	19	$ 26	$ 494	
Metals (Cu, Pb, and Zn) by EPA Method 6010	ea	19	$ 65	$ 1,235	
Perform independent data validation	ea	19	$ 20	$ 376	
Input analytical results into Presidio database	ea	19	$ 15	$ 285	
Prepare Excavation Report	ls	1	$ 25,000	$ 25,000	
					$ 60,190
Engineering Project Management					
9% of Design and Construction Management Services		9%			$ 5,417
Subtotal Estimated Costs (w/ contractor overhead and profit):					$ 193,000
Legal and Administrative Costs (assumed to be 5% of subtotal estimated costs w/ contractor overhead and profit):					$ 10,000
Subtotal Estimated Costs (w/ legal and administrative costs):					$ 203,000
Contingencies (assumed to be 20% of subtotal estimated costs w/ legal and administrative costs):					$ 41,000
Total Preliminary Estimated Capital Costs of Remedial Alternative:					**$ 244,000**

Table C-6
Barnard Avenue Protected Range - Alternative 4:
Estimated Costs to Excavate and Dispose of Soil
Small Arms Firing Range
Presidio of San Francisco, CA

Notes and Assumptions
1. Totals may not sum exactly because of rounding.
2. Field effort of excavation is assumed to be 1 week in duration.
3. Total volume of in-place soil is estimated to be 1,029 cy (bank yards). Volumes of soil from Figure 8. Volumes are presented in Table C-8.
4. Conversion factor from cy of soil to tons is 1.6 tons per cubic yard.
5. Conversion factor from cy of asphalt to tons is 1.7 tons per cubic yard.
6. Total volume of asphalt was increased by 10 percent to account for additional demolition during field effort.
7. Thickness of asphalt section is estimated to be 6 inches.
8. Sidewall confirmation samples will be collected at an approximate frequency of 1 sample per every 50 linear feet for a total of 15 samples. Samples will be analyzed for three metals (Cu, Pb, and Zn) (EPA 6010B).
9. Bottom confirmation samples will be collected at a frequency of 1 sample per 2,500 sf for a total of 4 samples. Samples will be analyzed for three metals (Cu, Pb, and Zn) (EPA 6010B).
10. Waste characterization samples will be collected approximately 1 per 500 cy. Samples will be analyzed for 6 Metals (Cd, Cr, Cu, Pb, Ni and Zn) (EPA 6010B), and total extractable petroluem hydrocarbons (EPA 8015M).
11. Land use controls are included to accomodate the future removal of Buildings 808 and 809.
12. Derivation of unit rates is presented in Table C-7.

Table C-7
Derivation of Unit Rates
Small Arms Firing Ranges
Presidio of San Francisco, California

Task Description	Unit	Unit Cost	Source
CAPITAL COSTS			
General Site Preparation			
Mobilize contractor equipment and supplies to site	ls	$ 1,000	Table E-3, Main Installation Sites FS, EKI, March 2003 (MIFS); used cost for "miscellaneous sites"
Erect and maintain perimeter temporary fence	ft	$ 10.00	MIFS
Pre-excavation, post-excavation and confirmation sample survey	area	$ 6,000	Towill Surveys
Cap Area and Confirmation Sample Surveys	area	$ 6,000	Towill Surveys
Decontamination area for personnel and equipment	ls	$ 1,500	Treadwell & Rollo, Inc. (T&R)
Provide Personnel Protective Equipment (PPE)	ls	$ 2,000	T&R
Excavate Waste and Soil			
Break and remove asphalt, recycle off-site	sf	$ 1.00	MIFS
Excavate soil, no segregation (3 cy bucket)	cy	$ 3.50	MIFS
Bunker Excavation (limited access)	cy	$ 100.00	MIFS; used cost for Bobcat excavation
Load excavated material into end-dumps	cy	$ 4.00	MIFS
Collect soil profile samples for disposal	ea	$ 26	MIFS
Disposal characterization			
Six metals (EPA Method 6010B)	ea	$ 125	MIFS
Total Extractable Petroleum Hydrocarbons (EPA 8015M), gas and diesel	ea	$ 140	MIFS
Dispose of RCRA hazardous soil at Class I facility	ton	$ 150	T&R (Lead Treatment Evaluation Memo, 2004)
Dispose of non-hazardous soil at Class II facility	ton	$ 35.00	Trust source
Repair Asphalt Areas			
Asphalt Sealing	sy	$ 1.25	Means

Table C-7
Derivation of Unit Rates
Small Arms Firing Ranges
Presidio of San Francisco, California

Task Description	Unit	Unit Cost	Source
CAPITAL COSTS			
Site Stabilization and Vegetation Replacement			
Import and Place Clean Fill	cy	$ 20	MIFS
Restore Asphalt	sf	$ 2.25	MIFS
Import and Place Clean Topsoil (12 inches)	cy	$ 30	MIFS
Vegetation Replacement (Riparian scrub)	acre	$ 52,200	Trust source, Aug. 5, 2004
Vegetation Replacement (Serpentinite scrub plants)	acre	$ 89,500	Trust source, Aug. 5, 2004
Furnish and install erosion control measures	sf	$ 0.333	MIFS
Land Use Controls, Area B (Buildings 808 and 809)			
Prepare Site-Specific Addendum to the Land Use Control Master Reference Report	site	$ 5,000	MIFS
Add Site-Specific Land Use Controls to Trust GIS System	site	$ 500	MIFS
Land Use Controls, Area A			
[Estimated]	site	$ 5,500	Current estimate will be updated when more information is available from National Park Service.
Data-gaps Investigation, to Confirm Extent of Cap			
Prepare additional characterization work plan	ls	$ 5,000	MIFS
Collect soil confirmation samples with hand auger	loc	$ 200	MIFS
Metals (Sb, Cu, Pb, and Zn) by EPA Method 6010	ea	$ 125	MIFS
Design and Construction Management Services - Excavation Remedy Engineering			
Perform general planning activities	ls	$ 10,000	MIFS (adjusted for smaller site)
Prepare remedial design	ls	$ 10,000	T&R (assume work plan and figures)
Coordinate with waste management facilities	ls	$ 1,000	MIFS (adjusted for smaller site)
Bid, award, and negotiate construction contract	ls	$ 2,500	MIFS (adjusted for smaller site)

Table C-7
Derivation of Unit Rates
Small Arms Firing Ranges
Presidio of San Francisco, California

Task Description	Unit	Unit Cost	Source
CAPITAL COSTS			
Construction observation			
Provide resident engineer	wk	$ 5,000	MIFS
Provide office support	wk	$ 2,000	MIFS
Provide vehicles and equipment	wk	$ 1,300	MIFS
Perform air monitoring	wk	$ 1,000	MIFS
Collect soil confirmation samples	ea	$ 26	MIFS
Metals (Cu, Pb, and Zn) by EPA Method 6010	ea	$ 125	MIFS
Perform independent data validation	ea	$ 20	MIFS
Input analytical results into Presidio database	ea	$ 15	MIFS
Prepare Excavation Report	ls	$ 25,000	MIFS
Prepare Data-gaps Investigation Report	ls	$ 10,000	T&R
Engineering Project Management	%	9	MIFS
Legal and Administrative Costs	%	5	MIFS
Contingencies	%	20	MIFS
ANNUAL COSTS			
Inspect and Clear Vegetaion from Drainge Ditches, Other Areas	ls	$ 1,000	MIFS (adjusted for smaller sites)
Repair Damage to Permeable Cover	ls	$ 1,000	MIFS (adjusted for smaller sites)
Project Management/Administration			
Annual administrative cost of Insitutional Controls	ls	$ 1,000	MIFS
Coordinate with NPS for Area A site	ls	$ 1,000	MIFS
Annualized cost of Five-Year Review (6 occurrences)	ls	$ 5,000	MIFS

Table C-8
Soil Volume Estimates
Small Arms Firing Ranges
Presidio of San Francisco, California

Barnard Avenue Protected Range

Area	Total Area (sq ft)	Vegetated Area (sq ft)	Asphalt Area (sq ft)	Perimeter (lf)	Depth (ft)	Volume (cy)
BAP1	4,845	4,845	--	283	2	359
BAP2	1,573	1,573	--	158	2	117
BAP3	1,806	1,024	782	160	4	268
BAP4	1,287	--	--	145	6	286
Total	9,511	7,442	782	746	14	1,029

California Highway Patrol Pistol Range

Area	Total Area (sq ft)	Vegetated Area (sq ft)	Asphalt Area (sq ft)	Perimeter (lf)	Depth (ft)	Volume (cy)
CHP1	664	622	42	101	1	25
CHP2	1,606	191	1,415	153	2	119
CHP3	1,560	154	1,406	151	3.5	202
CHP4	1,260	935	325	137	2	93
CHP5	515	444	71	87	4	76
CHP6	741	401	340	3	3	82
Total	6,346	2,747	3,599	632	15.5	598

Notes
-- = not applicable
cy = cubic yards
ft = feet
lf = linear feet
sq ft = square feet